

**GLYCEMIC INDEX OF IMPROVED RICE VARIETIES AS INFLUENCED BY  
DEGREE OF POLISHING AND PROXIMATE COMPOSITION INCLUDING  
AMYLOSE CONTENT**

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**EXTENDED ABSTRACT**

Type II diabetes is increasing at alarming rates in Sri Lanka and often not diagnosed until chronic conditions emerge. There were 1.16 million cases of diabetes in Sri Lanka in 2015 (IDF, 2015). Prevalence of diabetes mellitus is lower in people having diets with low glycemic index (GI) than in diets with high GI (McKeown *et al.*, 2004). GI could be considered as a valid parameter in this attempt as it ranks food items depending on the blood glucose response following a meal. GI is defined as ‘the incremental area under the blood glucose response curve of a 50 g digestible carbohydrate portion of a test food expressed as a percent of the response to the same amount of carbohydrate from a standard food taken by the same person’. Foods are categorized into low (55 or less), medium (56-69) and high (70 or above) GI groups (Wolever, 1991).

Rice as Sri Lankans’ staple food is consumed two or three times daily or at least once in main meals by a Sri Lankan. Studying the GI of Sri Lanka’s rice will be of immense importance in such a situation. GI values in white rice have been obtained within a wide range of variability from 54 to 121, in studies done around the world (Zarrati *et al.*, 2008). Protein, fat, fibre and other nutrients in rice that vary among varieties may also influence the carbohydrate absorption which is related to health condition of the rice consumer (Wolever and Jenkins, 1986). Rice market in Sri Lanka comprises of red, white, long and short grains and raw and parboiled rice. Comparative studies among improved rice varieties for their GI and influence of proximate composition and bran removal or degree of polishing on GI of rice are limited. Thus, the objective of the present study was to compare improved rice varieties developed at the

Rice Research Station (RRS), Ambalantota for their GI and to evaluate how degree of polishing and proximate composition including grain amylose content influence on GI.

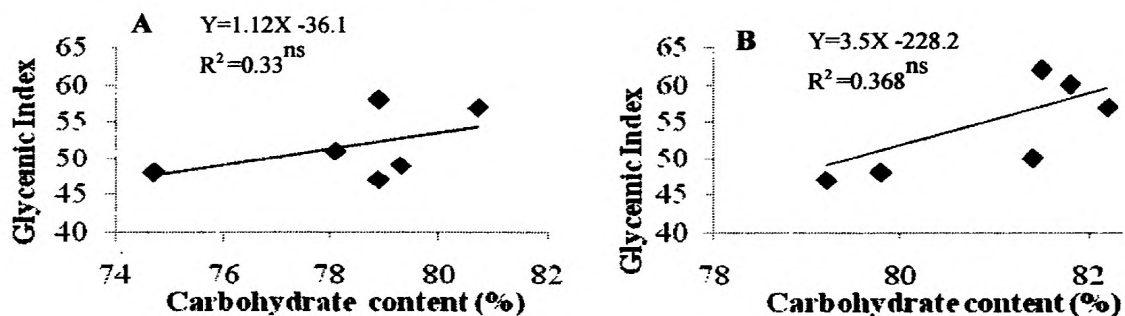
A two factor factorial (RCBD) experiment with seven rice varieties (At 362, At 311, At 353, At 1078, At 309, At 405 and At 354) and two degrees of polishing (DP) (30% and 60%) was conducted at the RRS, Ambalantota during 2014/15 *Maha* season. Proximate composition including moisture (M), crude protein (CP), crude fat (CFa), crude fibre (CFb), and total ash content was determined by the official method of analysis (AOAC, 2000). Available carbohydrate content was calculated by subtracting the total nutrients (M, CP, CFa, CFb and ash) by 100. Amylose content was determined by the method of Cruz and Kush (2000). In vivo test for GI was conducted as described by Panlasigui *et al.* (1991), Yusof (2005) and Zarrati (2008). Eleven non-smoking and non-diabetic healthy volunteers comprising 8 women and 3 men (age/yrs  $41.1 \pm 11.2$  and BMI  $24.9 \pm 1.05$ ) took part in the study. The respective blood glucose concentrations were used to draw a response curve for the 2hr. period. The incremental area under the curve (IAUC) was calculated for each meal in every volunteer separately (Chlup *et al.*, 2004). The GI for each tested food was calculated as the mean from the respective average GI's of the 11 volunteers. Data were analyzed using ANOVA procedure. Whenever the interaction effects were significant they were further studied using response curves. Relationships among variety characteristics were studied using regression analysis under two degrees of polishing separately if the interaction effect of variety  $\times$  degree of polishing for characteristics was found to be significant.

Two way interaction effect of Variety  $\times$  DP was found to be significant with respect to GI. None of the tested varieties recorded high GI values. Except At 405 and At 354, all the other varieties recorded almost the same GI irrespective of DP. At 362, At 311 and At 1078 recorded low GI values and At 353 and At 309 recorded intermediate GI values irrespective of DP. At 405 and At 354 appeared highly sensitive to DP with respect to GI as they recorded low GI values at 30% DP and intermediate GI at 60% DP. Thus, these can be made low or intermediate GI depending on the DP.

The interaction effect of variety  $\times$  DP was found to be significant for all the nutrient components of protein, fat, fibre, ash, carbohydrate and amylose indicating that different varieties responded differently to different degrees of polishing in all the nutrient components. In general, average effects of protein, fat, fibre and ash contents were significantly higher in rice varieties with 30% than 60% DP irrespective of the significant interaction effect of variety  $\times$  DP. Carbohydrate contents were in converse. This was because unlike carbohydrate, other components such as protein,

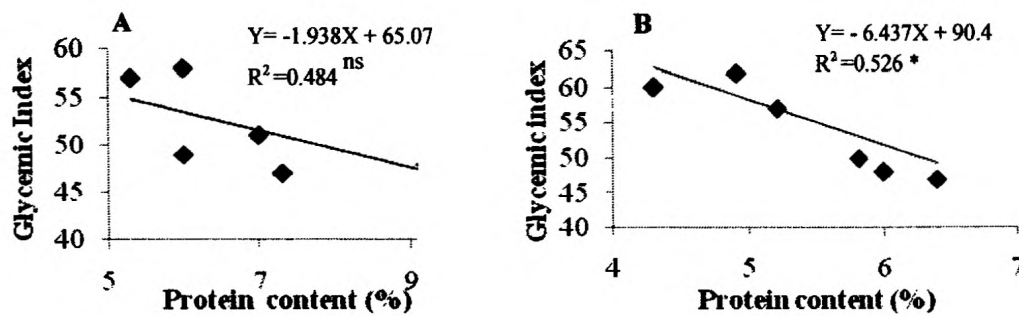
fat, fibre and minerals are concentrated in the rice bran (Champagne *et al.*, 2004). On the average At 354 recorded the highest (81.25%) and At 311 and At1078 recorded the lowest (77%) grain carbohydrate contents. The linear relationships between GI and grain carbohydrate content at both 30% and 60% DP were found to be not significant at 5% probability level, indicating that GI was not influenced by the grain carbohydrate content in improved rice irrespective of DP (Figure 1).

On the average At 354 recorded the lowest (4.8%) and At 311 and At 1078 recorded the highest (7.8%) grain protein contents. The relationship between GI and grain protein content was found to be not significant at 30% DP but was found to be significant at 60% DP at 5% probability level indicating that degree of polishing influenced the relationship between GI and grain protein content in improved rice (Figure 2). Higher the grain protein content, lower the GI in 60% polished rice and the rate of reduction in GI was 6.44 per 1% increase in grain protein content. This is in agreement with Chung *et al.* (2008) who reported comparatively lower GI values in samples with greater protein content. As a strategy, rice with more than 60% DP of varieties having grain protein content more than 5.5% can be considered as low GI (less than 55) rice.



**Figure 1.** The linear relationships between GI and grain carbohydrate content at 30% (A) and 60% (B) degrees of polishing in improved rice [ns=not significant at  $p \leq 0.05$ ].

The relationships between GI and grain fat ( $r^2 = 0.239$  at 30% and 0.45 at 60% DP), crude fibre ( $r^2 = 0.223$  at 30% and 0.006 at 60% DP), ash ( $r^2 = 0.002$  at 30% and 0.068 at 60% DP) and amylose contents ( $r^2 = 0.037$  at 30% and 0.055 at 60% DP) were found to be not significant at 5% probability level at both 30% and 60% DP indicating that GI was not influenced by any of those nutrients in improved rice irrespective of DP. Yusof *et al.* (2005) reported that though many factors contribute to influence GI, dietary fibre has no relationship to GI and Panlasigui *et al.* (1991) reported that amylose content in rice is not a good predictor for starch digestibility and glycemic response. Van *et al.*, (2015) also found that there was no correlation between amylose content and GI or the resistant starch content.



**Figure 2.** The linear relationships between GI and grain protein content at 30% (A) and 60% (B) degrees of polishing in improved rice. (\*=significant, ns=not significant at  $p \leq 0.05$ ).

GI of improved 'At' varieties ranged from low to medium. None of them recorded high GI. Influence of degree of polishing on GI was variety dependent. Grain carbohydrate, amylose, fat, crude fibre and ash contents had no influence on GI in improved 'At' rice. However, at 60% degree of polishing GI reduced from intermediate to low as the grain protein content increased but not at 30% degree of polishing.

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