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Estimation of Glycemic Index of Popular and Pre-released Rice Varieties of North Coastal Zone, Andhra Pradesh, India

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A B S T R A C T

Rice (*Oryza sativa*) being a staple food, it is important to know the level of glycemic index present in rice. General public especially diabetics have a notion that rice should not be eaten, as it's glycemic index value is high. However to identify whether it is of low GI or high GI, its glycemic value should be estimated. In the present study glycemic index was estimated for selected popular varieties of rice viz Srikakulam sannalu (RGL-2537) and Pre-released (RGL-11226) rice variety. Clinically healthy adult subjects (n=15) of age 18 - 22 years were selected for the study of glycemic index. The results showed that Srikakulam sannalu (RGL-2537) has got GI of 55.18 and Pre-released variety (RGL-11226) has got GI of 57.42. Based on these values Srikakulam sannalu (RGL-2537) can be categorized as low GI category and Pre-released variety (RGL-11226) under medium GI category.

Introduction

India is one of the world's largest producers of rice accounting for 20% of the world's rice production. Rice is India's pre-eminent crop and is the staple food of the people belonging eastern and southern parts of the country. Rice is a staple food consumed by more than half of the world's population (FAOSTAT, 2014). It provides 20% of the world's dietary energy supply, while wheat supplies 19% and maize 5% (FAO, 2004). It is the predominant dietary energy source for 17 countries in Asia and the Pacific, 9 countries in North and South Africa. In 59 countries, an average percentage availability of at least 75gms of rice is available (FAOSTAT, 2014). The total population of these countries is 4.1 billion which indicates that reaching the cereal requirement of even half of that population would ensure a greater daily nutrient intake among 2 billion people (FFI, 2014).

According to Jenkins *et al.,* (1981) Glycemic Index (GI) can be defined as the incremental area under blood glucose response curve of a 50 g carbohydrate from a reference food (white bread or glucose) taken by the same subject over a specified period of time. Rice being staple food for almost two third of the population plays a pivotal role in Indian economy (Anonymous, 2013). The slogan, "Rice is Life" is more appropriate for India as this crop plays a vital role in our National food security and is a means of livelihood for millions of rural households.

Rice is the main constituent of life-saving oral rehydration solutions (ORS), and has been used for treatment of various ailments such as diarrhea, vomiting, fever, hemorrhage, chest pain, wounds, and burns. Rice, a natural, wholesome grain that gets the majority of its calories (at least 85%) from complex carbohydrates, fits the definition of nutrient-dense.

Rice is also low in calories, providing 103-108 calories per half-cup of cooked rice(Betrez-Marquez *et a1*.,2005).Rice contributes over 15 essential nutrients to the diet, and is especially rich in B-vitamins, potassium, magnesium, selenium (brown), fiber (brown) and iron (USDA,2005).

However, the general public, especially diabetics have a notion that rice should not be eaten, as it's glycemic index is high, but the fact is that rice contains 20% amylose which has been shown to have a slower rate of digestion and produces lower glycemic and insulin responses (Miller *et al.*,1992). Despite numerous studies on different varieties of rice, there is lack of published data on glycemic index of newly released rice varieties of Andhra pradesh. The main objective of the study was to estimate the glycemic index levels of selected popular rice varieties viz Srikakulam sannalu (RGL-2537) and Pre-released (RGL-11226) rice varieties.

Materials and Methods

The glycemic index is the indexing of the glycemic response of a fixed amount of available carbohydrate from a test food to the same amount of available carbohydrate from a standard food consumed by the same subject. Fifteen clinically healthy adult subjects of age 18 - 22 years were selected for assessment of glycemic index of the two rice *(Oryza sativa)* varieties viz Srikakulam sannalu (RGL-2537) and Pre-released variety (RGL-11226) at Department of Foods and Nutrition, Post Graduate Research Centre, Professor Jayashankar Telangana state Agricultural University, Rajendranagar, Hyderabad.The food was prepared freshly in the morning on the day of the test.After an overnight fast, blood glucose was checked for fasting level and then the subjects were fed 50g of Glucon-D as a reference food and blood glucose was checked at 15, 30, 45, 60, 90 and 120 minutes according to the WHO method. The subjects were allowed on normal diet for next three days and then again after an overnight fast,the fasting blood glucose level was taken and then the subjects were fed with 50g of carbohydrate equaled test food i.e. Srikakulam sannalu (RGL-2537). Rice with little cumin seeds and salt without oil was prepared freshly in the morning on the day of the test. Subjects were given 15mins to complete the given test food portion with drinking water (250ml) and were asked to chew the food thoroughly and then blood glucose was checked at 15, 30, 45, 60, 90 and 120 minutes.

Then again the subjects were allowed on normal diet for next three days and then again after an overnight fast, the fasting blood glucose level was taken and then the subjects were fed with 50g of carbohydrate equaled second variety test food i.e. Pre-released variety (RGL-11226) in the same manners the first variety of rice. Subjects were given 15mins to complete the given test food portion with drinking water (250ml) and asked to

chew the food thoroughly and then blood glucose was checked at 15, 30, 45, 60, 90 and 120 minutes.

Blood sampling and analysis

Capillary blood was taken from finger tips for blood glucose estimation using Glucometer (One Touch). The blood samples were taken in fasting state (0 min) and at 15, 30, 45, 60, 90 and 120 min interval after ingestion of the reference food as well as test food. The subjects were restricted from performing any physical activity during 2 hr of study period. The area under curve of rice prepared were calculated for each subject. The Incremental Area Under Curve (IAUC) of both reference and test food was used to obtain the Glycemic Index (GI) by the following formula:

$$GI_{food} = \frac{IAUC \text{ in response to a relevent test food portion}}{IAUC \text{ in response to equal weight of reference food (Glucose)}} \times Amount \text{ of food (100)}$$

Statistical analysis (Analysis of Variance) was used to test the difference between means ($p<0.05$) level of significance using statistical software.

Results and Discussion

The mean fasting blood glucose level of the participants was 86.33± 9.15 mg/dl. The mean blood glucose level at 30 min and 60 min after the oral administration of 64g of digestible CHO. The selected rice varieties such as Srikakulam sannalu (RGL-2537) and Pre-released variety (RGL-11226) were 144.66±25.0 and 107.6±31.46. containing 64g of digestible carbohydrate were administered to the subjects.

The peak blood glucose response was obtained at 30 minutes for both the rice varieties. The mean glycemic response of Srikakulam sannalu (RGL-2537) and Pre-released variety (RGL-11226) at 30 minutes ranged between 124.73±19.98 and 129.8±22.07 respectively.

The mean blood glucose levels of glucose and test food Srikakulam sannalu (RGL-2537) are summarized in Table 1 and Pre-released variety (RGL-11226) are summarized in Table 2. When popular variety Srikakulam sannalu (RGL-2537) was orally administered it was observed that it had a maximum peak level of 124.73mg/dl at 30 minutes. Reference food (glucose) had a maximum peak level of 144.66mg/dl at 30 minutes.

Hence it was observed that the reference food (glucose) had a maximum peak level which was shown to be significantly lower than the test food (RGL-2537).The graphical representation is shown in Fig. 1.

Table.1 Mean blood glucose response to reference and test food (in mmol/L)

Time Interval	Blood Glucose Response to Reference Food(Glucose)(n=20)	Blood Glucose Response to Test Food(Srikakulam sannalu (RGL-2537Rice) (n=15)	P value
0 min(Fasting)	86.33±9.15	85.6±5.33	0.046
15 min	119.86±20.28	113±18.9	
30 min	144.66±25	124.73±20.0	
45 min	142.53±29.51	118.33±16.90	
60 min	107.6±31.46	109.86±13.27	
90 min	107.86±15.21	105.33±14.39	
120 min	94±15	100.06±10.69	

*Significance Level$P<0.05$

Table.2 Mean blood glucose response to reference and test food (in mmol/L)

Time Interval	Blood Glucose Response to Reference Food(Glucose)(n=20)	Blood Glucose Response to Test Food(Srikakulam sannalu (RGL-11226Rice) (n=15)	P value
0 min(Fasting)	86.33±9.15	85.4±6.64	0.043
15 min	119.86±20.28	116.6±17.6	
30 min	144.66±25	129.8±22	
45 min	142.53±29.51	111.33±16.77	
60 min	107.6±31.46	104.06±15.62	
90 min	107.86±15.21	103.6±12.81	
120 min	94±15	99.8±11.25	

*Significance LevelP<0.05

Figure.1 Mean blood glucose response to reference and test food (in mmol/L)

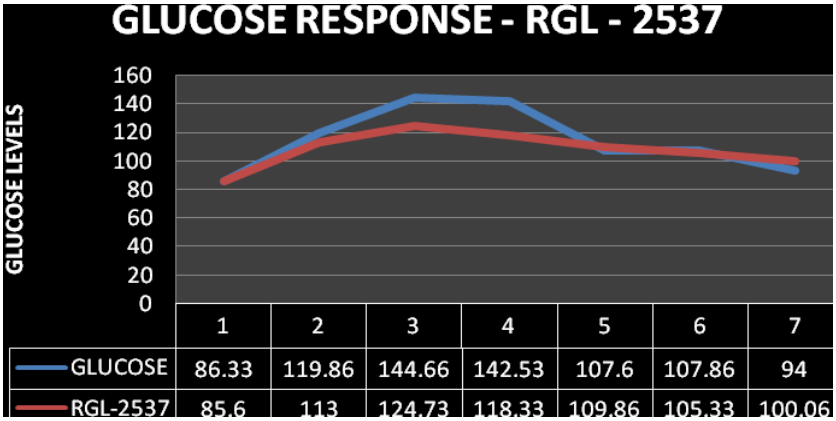
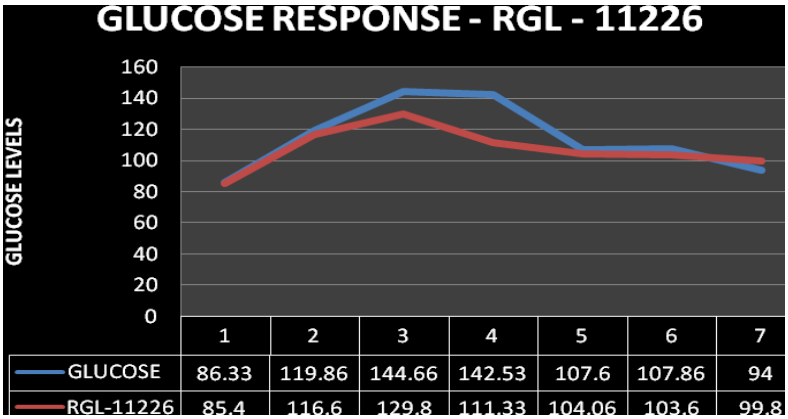


Figure.2 Mean blood glucose response to reference and test food (in mmol/L)



When pre-released variety (RGL-11226) was orally administered to the selected subjects, it showed a maximum peak level of 129.8mg/dl at 30 minutes and reference food (glucose) showed a maximum peak level of 144.66mg/dl for the same time. It was observed that reference food (glucose) had a maximum peak level which was shown to be significantly lower than the test food (RGL-11226). This shows that the maximum peak level of blood glucose was much more lower in the rice varieties compared to the reference food. The graphical representation is shown in Fig 2.

It was observed that there was no significant difference in fasting blood glucose level. At 30, 45 and 60 minutes significant difference was observed ($p<0.05$) between the reference food and test foods. At 90 and 120 minutes there was no significant difference between the reference food and test foods.

From the statistical analysis it was observed that there was no significant difference between the test foods, but there was significant difference ($p<0.05$) between the test foods and reference food (glucose).

Glycemic index was calculated for the two varieties of rice. Srikakulam sannalu (RGL-2537) and Pre-released variety (RGL-11226) had glycemic index levels of 55.18 and 57.42 respectively. The glycemic index foods are categorised as low (GI value < 55.99), medium (GI value 56-69.99) or high GI foods (> 70). Results showed that the glycemic index of Srikakulam sannalu (RGL-2537) was 55.18, hence it can be categorized as low GI food. Pre-released variety (RGL-11226) of rice had GI of 57.42 and can be categorized as medium GI food.

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