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ORIGINAL ARTICLE

Glycemic Index of Various Brands of Rice in Healthy Individuals

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Since the varying different contents of amylose in rice grains have different effects on blood sugar, we examined the effect of consumption of three varieties of rice on glucose response in healthy subjects, to compare the glycemic effects of 50 g carbohydrate in the Basmati, Kazemi and Sorna pearl varieties of rice in normal subjects.

Material and Methods: Thirty healthy subjects (13 males and 17 females), were evaluated 4 times at 1 week intervals. On the first day, all subjects consumed 50 g glucose, and were then divided into 3 groups. Each group consumed one of the 3 types of rice with 50 g carbohydrate content each week. Blood samples were collected before and at 15, 30, 60 nd 120 minutes after taking of glucose and rice consumption. The Glycemic index (GI) was calculated for each rice as the ratio of the incremental area under the 3-hour glycemic response curve to rice to the incremental area under the 3-hour glycemic response curve to 50 g glucose.

Results: The GIs of Sorna pearl, Kazemi and Basmati were 52.2±5.1, 67.6±13 and 61.2±6.1 respectively, with that of Sorna pearl being lower than the others ($p<0.05$). Maximum changes in blood sugar for Sorna pearl, Kazemi and Basmati were 21.8±12, 27.4±6 and 31.7±5.9 mg/dL, respectively.

Conclusion: Glycemic index and glycemic load for Sorna pearl rice were lower than for the other two rice types, difference statistically significant. The effect of Sorna pearl rice consumption in diabetes mellitus patients however needs more study.

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Introduction

Cereal products are the major source of carbohydrates in diets.[1] Rice has given a wide range of results in glycemic index (GI) studies around the world. Prevalences of diabetes mellitus, cardiovascular disease and metabolic syndrome are lower in subjects having diets with low glycemic response than in those with diets with a high glycemic index.[2] Two decades ago, Jenkins et al introduced the glycemic index as an alternative

method for classifying carbohydrate foods.[3] The GI of white rice has ranged from as low as 54 to as high as 121 with white bread as a reference (GI=100), which makes it difficult to classify rice according to its GI. If the rice has not been specifically tested, no specific advice can be given to diabetic patients. Oats, barely and rye, when used as whole grains, have low GI and rice would likely be the same.[4] Research has shown that diets with low GI improve glycemic response in patient with diabetes type 1 and 2.[5] In some of these studies, rice was classified as a low GI food, whereas in others it was reported among high GI foods. Much of the variation in the GI for rice is due to differences in the amylose to amylopectin ratio. Rice varieties with higher proportion of amylose have been shown to have a slower rate of digestion and produce lower glycemic and insulin responses.[6] Since there is not enough information on GI and insulin response to different varieties of rice in Iran, we conducted this study to determine blood glucose and insulin response followed by rice consumption in healthy individuals; to do so we compared the Sorna pearl rice variety to two other frequently used varieties, the first one called Kazemi, a domestic brand and the second, Basmati, an imported variety.

Materials and Methods

Thirty nonsmoking and non-diabetic volunteers (age range 20-40 y) took part in our study; their mean body mass index (BMI) was 23±0.8, with all volunteers having normal fasting plasma glucose (<126 mg/dL) at baseline. Written informed consent was obtained from all subjects before the study. Blood pressure was measured two times after 15 min resting; subjects had fasted 8-12 hours prior to BP assessment. Body weight was measured without shoes, using a digital scale, and height was measured by metric standards. To calculate BMI, weight (kg) was divided by height (m) squared. Waist circumference, taken between the lowest rib and iliac crest and hip, was measured at the widest region around the pelvic area over light clothing by metric standards. On the morning of the study, all types of rice containing 50 g available carbohydrate were cooked with 2% salt and without any oil. Cooking and consumption of rice was monitored by a nutrition specialist. The subjects, divided into three groups (n=10 each) were assayed at one week intervals. Each group consumed one of the 3 rice types, with a 50 g carbohydrate content, each week. Venous blood samples were obtained at 0, 15, 30, 60 and 120 min after the test began. Plasma glucose was analyzed with the glucose oxidize technique with an otoanalyzer system and insulin with ELISA kit, Mercodia AB, Uppsala, Sweden. In this study the glycemic index (GI) for each rice was calculated by dividing the area under the incremental curve for rice to same area of curve for glucose. For the insulin index, the area under curve insulin for rice was divided to area under curve insulin for glucose. The amount of carbohydrate for each rice was calculated as well. The iron content was measured by atomic absorption, protein content by Kjeldahl, fat and ash by the Soxhlet method, moisture by Karl Fischer titration and fiber by the optic method. The statistical significance of the differences between values was assessed by using repeated measure analysis of variance. Interventional factors like sex, blood pressure, medication and cigarette was accumulated.

Results

Mean age of study subjects for women was 33±1y and for men was 37±2 y. Average and standard deviation for age, BMI, blood pressure and fasting blood sugar (FBS), based on sex are shown in Table 1.

Table 1. Characteristics of study participants

Sex	Age (Years)	BMI (Kg/m^2)	FBS (mg/dL)	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)
Men	37±2† *	24±0.7 *	91±4 *	130±7 *	86±3 *
Women	33±1	23±0.1	88±7	120±6	79±7
Average	35±2	23±0.8	89±7	123±6	81±7

* $p<0.05$ compared to female; † Mean ± standard deviation

Averages for FBS and BMI of subjects were 89±7 mg/dL, 23±0.8 Kg/m^2 respectively. Table 1 shows all study participants to have normal FBS, weight and blood pressure.

The results of chemical compounds, nutrients and energy for all rice varieties are shown in Table 2.

Table 2. Weight, composition and different nutrient contests of three varieties of tested rice with 50 g carbohydrate

	Crude Weight (gr)	Energy (kilocalorie)	Ash (gr)	Protein (gr)	Fiber (gr)	Moisture (gr)	Fat (gr)	Amylose (gr)	Ca (mg)	Fe (mg)	Zn (mg)	Vit B1 (mg)
Sorna pearl	65.3	212	0.3	6.6	0.2	7.6	0.4	32	0.3	0.3	1.6	0.06
Kazemi	61.6	205	0.2	5.1	0.3	5.6	0.3	27	0.4	0.2	1.3	0.06
Basmati	63.6	207	0.2	5.8	0.1	7.2	0.2	31	0.02	0.4	1.8	0.06

The Sorna pearl variety had the highest amylase content, while the Kazemi brand had the lowest. The contents of vitamin B_1 were similar for all varieties, but Iron and Zinc in the Basmati variety were higher, with calcium in the Kazemi variety being higher than the other two. The blood sugar elevation for all 3 varieties after consumption of 50 g carbohydrate is shown in Table 3.

Table 3. Comparison of mean glycemic index, glycemia load and insulin indexes in three different varieties of rice

	Sorna pearl	Kazemi	Basmati	p
Glycemic index	52.2±5.1	67.6±13	61.2±6.1	<0.01
Maximum(mg/dL)*Δ	21.8±12	27.4±6	37.1±5.9	<0.01
T maximum(min) †	30	15	30	-
Insulin index	47.3±4.2	61.6±8.9	52.3±3.1	<0.01
Glycemic load	22.4±2.2	30.7±5.9	26.1±2.6	<0.01

*maximum changes in blood glucose before and after consumption of 50 gr carbohydrate; † the duration of reaching the blood sugar to in highest value after consumption of 50 gr carbohydrate.

The glycemic indexes of Sorna pearl, Kasemi and Basmati were 52.2±5.1, 67.6±13 and 61.2±6.1 respectively, GI of the Sorna pearl variety being lower than the others ($p<0.05$). Maximum changes of blood sugar for Sorna pearl, Kasemi and Basmati were

21.8±12, 27.4±6 and 31.7±5.9 mg/min/dL respectively, the lowest insulin index and glycemic load was observed for the Sorna pearl variety. Fig. 1 shows the change of blood glucose after 2 hours. Area under curve based on mg/min/dl for the Sorna pearl, Kazemi and Basmati varieties of rice were 1180±368, 1481±312 and 1375±413 mg/min/dL respectively.

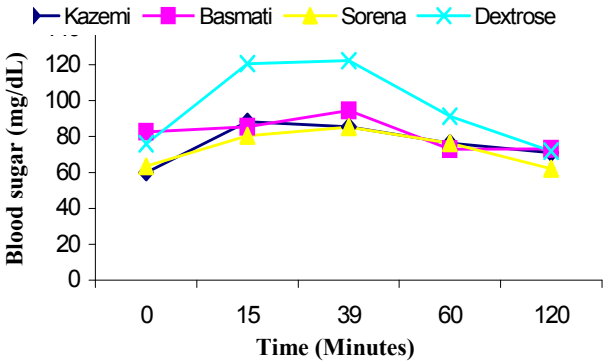

Fig.1. Mean blood glucose responses of subjects to dextrose for the Kazemi, Basmati and Sorna pearl rice varieties over a 120 min duration (n=30)

Discussion

In this study performed on non-diabetics, the GI of Sorna pearl rice was lower than for the other two varieties. According to recent studies such as the Juliano study, GI of rice was categorized in "Foods with high GI";[7] however in our study, which investigated one kind of Iranian rice "Kazemi" and two kinds of foreign rice, i.e Sorna pearl and Basmati, we found that the GI of any variety of rice depended on the kind of rice; Sorna pearl rice has the lowest GI and was categorized in food with low GI. Findings of this study are similar to those of the Frei M, et al. study,[8] where Frei and his colleagues assessed GI of six different kinds of rice and found that the low content of amylose and low volume during the cooking process were two predicting factors in high GI. Miller and his colleagues found that the amylose to amylopectin ratio in carbohydrate foods played an essential role in blood glucose levels.[9] In the present study, the Sorna pearl variety has lower effects on blood glucose than did the other two, due to a high amylose content; the intestinal amylase enzyme has a lower effect on rice with higher amylose and results in decrease or changes in blood glucose level, due to gradual rice digestion.[10] Jenkinz et al showed that fibers in cereal, because of low viscosity, were not effective on blood glucose response.[3] In our study, neither was there a significant correlation in the fiber content of the three varieties of rice, nor was there the possibility of measuring their total fibers. In the Lovitan et al study, analyzing the effect of GI on diabetes mellitus (DM), cardiovascular disease (CVD) and insulin resistantce, they found an adverse correlation between GI and morbidity of these diseases.[11] Today GL has more value in DM than GI.[12] In our study, we found that Sorna pearl rice has the lowest GL, which is important to mention, although in our study there is little difference in the rice amylose content but it may have significant positive effect on blood glucose. In the Panlasigui study, the effect of physical or chemical changes like temperature for gelatination, cooking time and increase in volume during cooking was seen on both GI and GL; in general, they concluded that amylose is not the single predictor factor in carbohydrate or GI, but it could be a preventive factor in blood glucose changes in DM patient.[13] In the present study, we did not assess these factors and we highly recommend future investigations of the factors mentioned. Regarding limitations of this study we could not measure total fiber because we lacked the related instruments. Hence we were unable to assess the correlation between GI and fiber content in diets. Also blood glucose levels may change due to genetics or other effects besides diets.[14] Our findings are about normal and healthy persons and we cannot generalize them to diabetics.

To conclude, GI and GL for the Sorna pearl rice is lower than the other two varieties, having significant statistical value. The

effects of Sorna pearl rice consumption in DM patients definitely needs more study.

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