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The Effect of Cooking Method on the Glycemic Index of Kalat Rice

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Abstract

Background: Rice is considered a major source of carbohydrates in most parts of Iran and many other countries. The quality of carbohydrates expressed as glycemic index (GI) has been known to play a key role in chronic diseases such as diabetes, cardiovascular problems and even cancer. Determining the GI of different types of rice and the effect of cooking methods on this index is therefore crucial.
Objectives: The present study was conducted to determine the effects of two different cooking methods on the GI of Kalat rice as a popular rice in Iran.
Methods: Ten healthy male participants with similar activity levels, i.e. no exercise, were recruited from Mashhad University of medical Sciences, Mashhad, Iran. The participants consumed the test meal, steamed rice and boiled rice each in a different day. Blood glucose levels were measured at the time points of -5, 0, 30, 60, 90 and 120 minutes. Repeated measures ANOVA was used to analyze the data.
Results: The GIs of boiled and steamed Kalat rice were respectively found to be 89.4 and 89.2, suggesting no significant differences. Moreover, the glycemic loads (GLs) of boiled and steamed Kalat rice were respectively found to be 23.01 and 23.87. The GI and GL of Kalat rice were therefore high compared to those of other types of Iranian rice.
Conclusions: Cutting down on Kalat rice is beneficial, specifically in individuals at risk for developing chronic diseases.

Keywords: Glycemic Index, Carbohydrates, Rice, Kalat

1. Background

GI is defined as the relative ability of a carbohydrate to increase blood glucose levels within a short period of its consumption. GL is another important factor that is defined as GI multiplied by the amount of carbohydrate in the food. GL is a more general index reflecting the amount of carbohydrates and their quality in a specific food (1, 2). Foods with different GIs differently affect blood glucose levels and insulin secretion. GI has been shown to be associated with certain factors such as the type of carbohydrate and processing method (3).

A large body of literature has found chronic diseases such as diabetes, cardiovascular problems and cancer to be associated with glucose metabolism and GL/GI. Diets comprising high-GI foods are associated with obesity. These findings along with the currently-growing consumption of very-low fiber carbohydrates alarm all health experts and nutritionists. Research suggests that consuming diets with a low GL or GI can help lose weight and alleviate type 2 diabetes (3).

White rice is the staple diet and the main carbohydrate source in the urban Iranian population as a vulnerable community to chronic diseases compared to the rural population owing do their rarely taking exercise (4), consuming inadequate amounts of vegetables, fruits and nuts and living in more stressful conditions. Determining GI is therefore essential for preventing the health problems cited in this community (4-6). Many studies conducted so far have proposed the wide range of 12 to 54 as the GI of rice, which is far from being definitely low or high (2), and more importantly, suggests the existence of different types of rice with completely different GI. Estimating the GI of rice is therefore essential for diet planning (7).

As discussed earlier, processing methods affect GI. In Iran, different types of rice are cooked using different methods. Nematy et al. found different cooking methods,

including boiling and steaming, to cause a change in the GI of Tarom rice.

2. Objectives

The present study was conducted to determine the GI of Kalat rice, as a popular type of rice, cooked through boiling and steaming as two most common cooking methods (7).

3. Methods

The present interventional study examined the participants before and after the intervention. This study was conducted in the Department of Nutrition, School of Medicine, Mashhad University of Medical Sciences. The Medical Ethics Committee of the University approved the present research (2298/1392), and all the participants were briefed on the study objectives, and asked to sign informed written consent forms before participating in the study.

3.1. Participants

The present study was conducted on ten healthy male volunteers as Mashhad residents aged 18 - 45 years and with a BMI of 18.5 - 30. The sample-size calculation method proposed by Louise was used to examine the GI of Basmati rice, and convenience sampling to select the subjects. The exclusion criteria comprised pregnancy and breastfeeding and a history of drug abuse, hypertension and diabetes.

The subjects were instructed to avoid strenuous physical activities, drinking, drug abuse and smoking for one day before the experiments. They were also required to fast for ten hours overnight before attending each testing session and to eat their last meal within the previous 18 hours.

On the first three visits, the subjects were given glucose (dextrose monohydrate) as the reference food. Fifty g of glucose powder was dissolved in 250 mL of distilled water. The test meal was also provided using Tarom rice cooked through the two methods cited. The subjects were provided with 50 g of the available carbohydrate portion for the test meal along with 100 mL of distilled water. Cooking was performed according to a nutritionist's instructions.

Boiled rice was prepared by boiling the rice in water, and steamed rice by boiling and then filtering the rice and cooking it at a low temperature for about one hour.

The subjects were provided with boiled Tarom rice on their first visit and steamed Tarom rice on their second visit (7). Table 1 presents the composition of the steamed and boiled Tarom rice determined in a laboratory.

Table 1 presents the GI and GL associated with different cooking methods. By definition, GL was calculated through multiplying GI by the amount of carbohydrate of the test meal divided by 100.

Table 1. GI and GL of Two Cooking Methods of Kalat Rice

Cooking Methods	Glycemic Index	Glycemic Load
Steamed cooked	89.2	23.1
Boiled cooked	89.4	21.92

In line with a previous study by the authors (7), fasting finger-stick blood glucose was measured using a glucometer (Accu-Chek Active, Roche, Mannheim, Germany) five minutes before, immediately after and 15, 30, 45, 60, 90 and 120 minutes after consuming the test and reference meals.

To calculate GI, the area under the curve (AUC) of blood glucose response was determined through measuring incremental area under the blood glucose curve while ignoring the area beneath the fasting concentration line. The trapezoidal rule was also used to include only the area above the fasting level when blood glucose fell below the baseline. The positive increment in the AUC was calculated for post-prandial plasma glucose in each subject and for each test. To determine the GI of boiled and steamed Tarom rice, the AUC was calculated for both the reference meal and the test meal (7).

3.2. Data Analysis and Statistical Methods

The data expressed as mean $\pm$ standard deviation (SD) were analyzed in SPSS-20. $P < 0.05$ was set as the level of statistical significance. Repeated measures ANOVA and the Tukey test were used to determine differences between the GIs of boiled and steamed Tarom rice.

3.3. Testing Sessions

The procedure used for two types of rice cooking methods and the protocol used to measure the effect of rice on blood glucose levels were perfectly consistent with the measurement method proposed by Nematy et al. for the GI of boiled and steamed Tarom rice (7).

4. Results

Table 2 presents the mean blood glucose levels and the blood glucose response curve in three groups, including a group consuming glucose and two others consuming either boiled rice or steamed rice. Table 2 suggests no significant differences in blood glucose levels between the reference group consuming the glucose solution and the experimental groups consuming either steamed Kalat rice or boiled Kalat rice ($P = 0.370$).

Table 2. Frequency of the Mean of Blood Glucose of Steamed Cooked, Boiled Cooked and Standard[a]

Groups	The Mean of Blood Glucose, min					The Blood Glucose, min	
	30	60	90	120	Response Curve	-5	0
Steamed cooked	102.5 ± 11.9	106.9 ± 9.7	108.5 ± 14.5	143.2 ± 29	139 ± 19.2	128.1 ± 19.4	114.2 ± 16.1
Boiled cooked	102.4 ± 9.5	104.5 ± 10.2	110 ± 14.7	139.5 ± 26.3	128.5 ± 14.1	121.2 ± 21.8	120.7 ± 15.8
Standard (glucose)	107.70 ± 6.3	119.8 ± 18.8	136.1 ± 17.1	177.9 ± 27.2	155.9 ± 30.3	134.30 ± 25.7	115.7 ± 19

[a] ANOVA test: F = 1.089, P value = 0.370.

Table 3 presents GI by cooking method, while multiplying all the results by 100 to present them in percentage. To calculate the GI of rice in each cooking method the blood glucose response curve associated with each cooking method was divided by that of the glucose solution.

Figure 1 shows the mean blood glucose associated with the reference meal and the boiled and steamed rice at different time points, suggesting a blood glucose peak thirty minutes after consuming the rice cooked using either method followed by a declining trend.

5. Discussion

The present study was conducted to determine the GI of Kalat rice cooked through boiling and steaming. Determining the GI of different types of rice and the effect of processing methods on this index (3, 8) is crucial given the growing prevalence of obesity and chronic diseases in urban areas and the contribution of the carbohydrate content of foods, denoted as GI, to some of these diseases, including diabetes, cancer and cardiovascular problems, as reflected in literature. Rice is the main source of carbohydrates in many parts of Iran, and there are different types of rice with different GIs in this country (6). Besides, research suggest that not only the GI of different types of rice differ from each other, cooking methods also affect the GI of rice (9, 10). Determining the GI of all types of rice is therefore essential for selecting the appropriate types, especially for individuals at risk for developing the chronic diseases cited along with determining the effect of cooking method on it.

The present findings suggested that, irrespective of the cooking method, the GI of Kalat rice is higher than that of Tarom as another popular and wildly-used rice in Iran (7). The GI of Kalat calculated in the present study is also higher than that obtained for other types of Iranian rice, including the one reported as 67.6 by Ali Kazemi, and that of foreign rice, including Basmati (67.2) and Sorna (52.2) (11).

Not only the GI of Kalat rice is higher than that of other types of rice, but also it is higher than that of certain types of honey (12, 13) and potato (14) and certain brands of spaghetti (15), as reported in literature. This finding is consistent with the findings of other studies placing rice in the category of "high-GI foods" (16, 17). Nutritionists and health practitioners who are involved in diet planning are recommended to consider the differences between the GI of these commonly-used foods and especially rice to help individuals with their optimal planning of diet and selecting rice with the minimum GI; nevertheless, the amount and quality of carbohydrates reflected in GL has recently attracted the attention of researchers more compared to GI in terms of predicting certain chronic diseases such as diabetes (18, 19). More effectively controlling both the amount of carbohydrate consumed in each meal and the GI can therefore help prevent chronic diseases such as diabetes.

The GIs of boiled (89.4) and steamed (89.2) Kalat rice were respectively found to be 1.16 times and 1.06 times that of Tarom (76.8). Although the GI of steamed Tarom rice was higher than that of boiled Tarom rice, these two cooking methods were found to be insignificantly different in terms of their effect on the GI of Kalat rice (7). This difference between Tarom and Kalat rice can be explained by their different contents. Factors such as the amylose content are associated with the effect of consumed rice on blood glucose levels given that the intestinal enzyme of amylase cannot significantly affect high-amylose rice, resulting in a relatively slowed-down digestion with no sharp rise in blood glucose levels (10, 20, 21); nevertheless, Zarrati et al. reported significant differences in blood glucose levels caused by a slight change in the amylose content (11). This finding suggests that the effect of the amylose content on blood glucose is mediated by other factors. Research suggests that, in addition to the amylose content, the fiber content, processing factors such as cooking duration and volume as well as chemical and physical factors can affect the GI of a food (9-11). Further studies are yet to be conducted to examine these factors in more detail. The limitations of the present study that should be taken care of when interpreting the results include failing to investigate the relationship of GI with other potentially-effective factors in GI, including the amyloid or fiber content. Different types of food are recommended to be compared in

Table 3. The Composition of the Steamed and Boiled Cooked Kalat Rice

Cooking Method	Carbohydrate, %	Fiber, %	Water, %	Protein, %	Fat, %
Steamed cooked	23.40	0.38	44.60	2.09	0.06
Boiled cooked	25.74	1.30	41.85	1.85	0.38

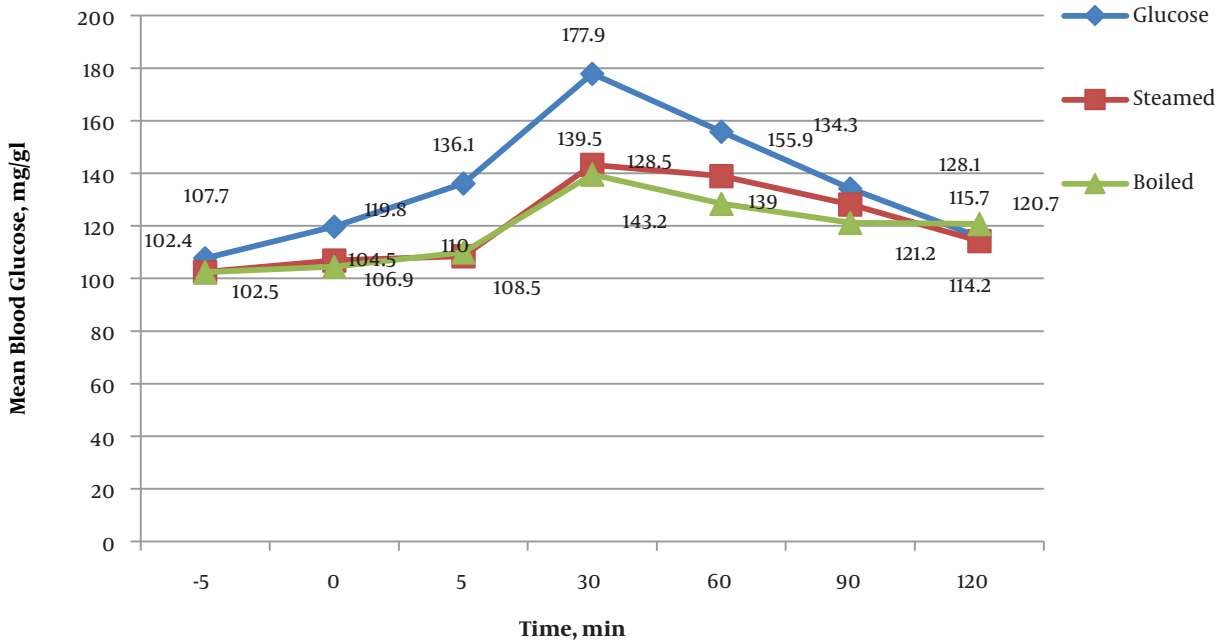

Figure 1. The mean blood glucose of standard, boiled and steamed cooked in different times

terms of their effects on blood glucose levels in one subject.

5.1. Conclusions

Given the relatively-high GI of Kalat rice, individuals, especially those at high risks for developing chronic diseases, are recommended to consume other types of rice such as Tarom or Kazemi.

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Footnotes

Authors' Contribution: Study design: Ayoub Tavakolian, Mohsen Nematy and Abdolreza Nourozy; providing patients to the study and laboratory support: Ayoub Tavakolian; data collection: Ayoub Tavakolian; data analysis: Ayoub Tavakolian, Mohsen Nematy, Abdolreza Nourozy and Saeed Akhlaghi; writing: Ayoub Tavakolian, Mohsen Nematy, Abdolreza Nourozy and Saeid Akhlaghi.

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