Comparison Effect of Black Glutinous Rice and Black Non-Glutinous Rice on Blood Glucose and Insulin Levels in People with Normal Blood Glucose

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ABSTRACT

Diabetes is a serious health problem for people around the world, and it is increasing with significant medical and economic consequences due to patients developing chronic complications. Postprandial glycemic control is very important in preventing diabetes and slowing its complications.

One study found that 66% of diabetic patients mainly consumed glutinous rice and those patients had higher HbA1c than those who mainly consumed white non-glutinous rice. The aim of this study was to compare the effect of black glutinous rice and black non-glutinous rice on blood glucose and insulin levels in people with normal blood glucose also to explore the behavior and satisfaction of consuming rice. This information would be used to develop advice on rice consumption.

This was an open-label randomized crossover study. Sixteen subjects, having normal blood glucose levels, randomly ate 90 kcal of black glutinous rice or black non-glutinous rice. Blood samples were collected for analysis of glucose and insulin levels 4 times, including fasting, 30, 60 and 120 minutes.

Statistical analysis was performed by paired T-test and incremental area under the curve (iAUC). The results showed that there was no statistically significant difference of changes in blood glucose and insulin levels between the black glutinous and black non-glutinous rice groups. I recommend eating black glutinous rice or black non-glutinous rice as a food exchange while considering the proportion of food to be consumed.

Result from the questionnaire showed that, rice, the subjects consume the most in daily life is white non-glutinous rice (75%). The second is white glutinous rice (18.75%). The third is brown non-glutinous rice (6.25%). The subjects prefer black glutinous rice rather than black non-glutinous rice in taste, feeling their hunger satisfied after eating, and the time between feeling hungry again. In contrast, they prefer black non-glutinous rice to black glutinous rice in terms of ease of supply, price and cooking methods.

INTRODUCTION

Diabetes is a serious health problem for people around the world, and it is increasing with significant medical and economic consequences due to patients developing chronic complications. Postprandial glycemic control is very important in preventing diabetes and slowing its complications.

One study found that 66% of diabetic patients mainly consumed glutinous rice and those patients had higher HbA1c than those who mainly consumed white non-glutinous rice. The aim of this study was to compare the effect of black glutinous rice and black non-glutinous rice on blood glucose and insulin levels in people with normal blood glucose also to explore the behavior and satisfaction of consuming rice. This information would be used to develop advice on rice consumption.

LITERATURE REVIEWS

I.   Natapong Kosachunhanun et al. (2003). Comparing the effect of sticky rice and white rice on glycemic control in type 2 diabetic subjects. The study from Faculty of Medicine, Chiang Mai University found that 66% of diabetic patients mainly consumed glutinous rice. And those patients had higher HbA1c levels than those who mainly consumed white non-glutinous rice.

II.   The study of amylose and amylopectin content in rice (Sunee et al, 2015) found that Hom Nil rice contains 24.1 g amylose per 100 g of raw rice and 75.9 g amylopectin per 100 g of raw rice. Black glutinous rice contains 7.4 g amylose per 100 g of raw rice and 92.6 g amylopectin per 100 g of raw rice.

III.   (Seki et al, 2005) High fiber content: Reduce intestinal glucose absorption , blood glucose increases less than consuming white rice

IV.   Food synergy: the key to healthy diet. (Jacobs and Tapsell, 2007) The properties of vitamins , minerals and antioxidants that work together in many mechanisms (food synergy) which controls blood glucose level.

METHODS

This was an open-label randomized crossover study. Sixteen subjects , having normal blood glucose levels at OPD of Mit Maitree Medical Clinics , randomly assigned for 2 groups. The first group ate 90 kcal of black glutinous rice and then switched having 90 kcal of black non-glutinous rice in the next two weeks, while another group ate black non-glutinous rice first and then switched having black glutinous rice.

The different types of rice have different nutrients. In this study had selected the rice with similar nutrients and phytochemicals. For black non-glutinous rice , use cooked Hom-nil rice 65 g which is 90 kcal and black glutinous rice, use cooked Neaw Dum 35 g.

Blood samples were collected for analysis of glucose and insulin levels 4 times, including fasting, 30, 60 and 120 minutes.

The subjects received a control meal for dinner before the experimental days, which was brown rice and fried chicken with basil and scald vegetables. The meal provides energy 310 kcal, carbohydrate 35 g, protein 37 g and fat 2.5 g.

The study analyzed statistical data using R program version 3.4.3. For statistical analyzing of the glucose and insulin levels after having each rice at the same time by using the student's paired T-test and analyzing the incremental area under the curve (iAUC) of blood glucose and insulin levels after having rice.

FINDINGS

This study started from April the 7th, 2018, to June 26th, 2018. There were 22 recruited subjects. Three people were excluded because of the DTX is greater than or equal to 100 mg%. And three people could not stay until finishing the whole process. Total number of the subjects were 16 people.

Table 1. Baseline characteristics of the subjects

Baseline characteristics of the subjects	
Age (year)	25.9 ± 4.2
Sex	
Male (person)	4 (25)
Female (person)	12 (75)
Body weight (kg)	60.0 ± 13.7
Height (cm)	162.1 ± 8.6
Body Mass Index (kg/m^2)	22.6 ± 3.3
Systolic blood pressure (mmHg)	106.7 ± 9.7
Diastolic blood pressure (mmHg)	64.6 ± 10.5
Heart rate (beat per minute)	75.5 ± 11.9
Underlying disease (person)	0
History of drug use (person)	0
Food allergy (person)	2 (12.5)
Supplements/Herbs (person)	0
Dextrostrip (mg/dL)	87.0 ± 7.6

All health parameters of the subjects are in normal levels. (Table 1)

Table 2. Mean of blood glucose and insulin levels comparing between black non-glutinous rice and black glutinous rice while fasting after meal 30, 60, and 120 minutes

	Black non-glutinous rice Mean (SD)	Black glutinous rice Mean (SD)	P-value
Blood glucose			
Fasting	82.1 (6.3)	86.1 (5.1)	0.034*
Postprandial 30 min	108.5 (17.7)	109.3 (12.5)	0.873
Postprandial 60 min	88.2 (15.3)	90 (11.8)	0.699
Postprandial 120 min	77.4 (8.4)	83.3 (5.1)	0.014*
Insulin levels			
Fasting	8.4 (0.4)	7.3 (2.1)	0.243
Postprandial 30 min	37.6 (24.2)	27.8 (13.3)	0.143
Postprandial 60 min	19.9 (15.4)	14.6 (4.3)	0.070
Postprandial 120 min	6.9 (4.4)	8.2 (5.1)	0.251

Note : * means statistically significant ($P < 0.05$)

The blood glucose before and after having meal at 120 minutes of both groups; there were significant differences. While there were no significant differences on blood insulin levels at all periods of 2 groups. (Table 2)

Figure 1. Incremental area under blood glucose curve, iAUC and incremental area under insulin curve
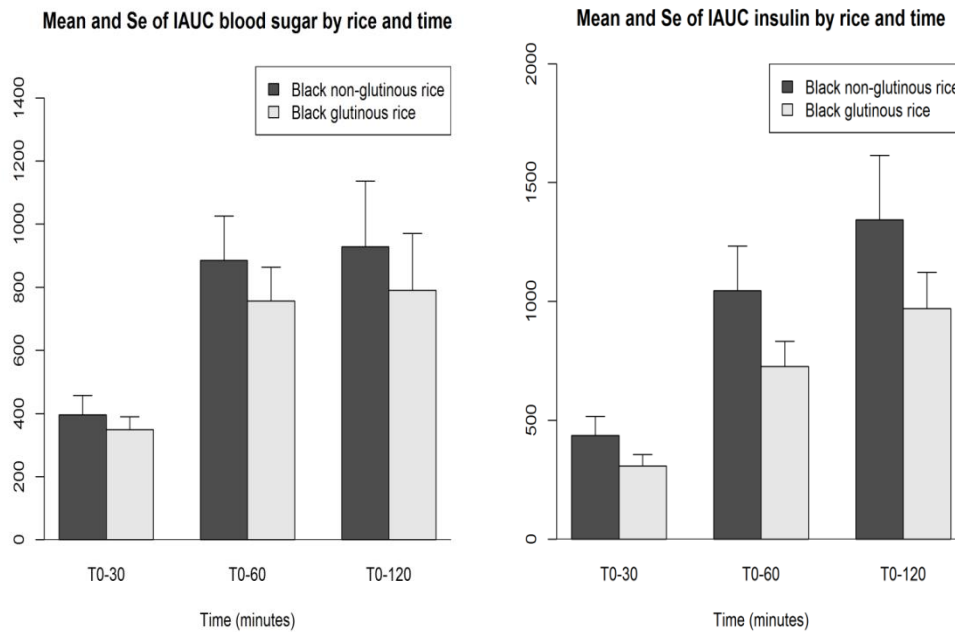
There was no significant difference of incremental area under blood glucose curves after having rice of both groups. And there was no significant difference of incremental area under insulin curves after having rice of both groups. (Figure 1)

Table 3. Number and percentage of the most common types of rice to be consumed in daily life.

Type of rice	Number (%)
white non-glutinous rice	12 (75)
brown non-glutinous rice	1 (6.25)
white glutinous rice	3 (18.75)
black glutinous rice	0

The result from the questionnaire which showed that, rice, the subjects consume the most in daily life is white non-glutinous rice (75%). The second is white glutinous rice (18.75%). The third is brown non-glutinous rice (6.25%). (Table 3)

Table 4. Rice consumption satisfaction.

	Black non-glutinous rice Mean (SD)	Black glutinous rice Mean (SD)
Taste, color, smell	4.1 (0.6)	4.3 (0.9)
feeling their hunger satisfied after eating	3.9 (1)	4.2 (0.9)
the time between feeling hungry again	3.2 (0.9)	3.6 (1.1)
ease of supply	4.4 (0.9)	3.4 (1)
price	4 (0.7)	3.6 (0.7)
cooking methods	3.9 (0.9)	3.4 (1)
Average	3.9 (0.5)	3.8 (0.6)

Note : the scores ranged from 1-5, 1 = least satisfied 5 = most satisfied.

The subjects prefer black glutinous rice rather than black non-glutinous rice in taste, feeling their hunger satisfied after eating, and the time between feeling hungry again. In contrast, they prefer black non-glutinous rice to black glutinous rice in terms of ease of supply, price and cooking methods but the averages of scores are similar. (Table 4)

DISCUSSIONS

When considering the blood glucose levels, they were found that the blood glucose levels of two groups were different before having meal. Which should not be different because it is the baseline level of the same subjects. (Table 2)

The subjects were asked about the types and the amount of food which they had consumed differently during the week before the experiments and found that, 6 subjects ate some foods that may affect blood glucose levels : 3 subjects drank soft drinks , 1 subject ate white sticky rice , 1 subject ate Thai desserts and 1 subject ate sweet fruits. When comparing with the experimental results found that, the difference of mean blood glucose levels on fasting of these six subjects was 11.17 mg / dL. This can be explained why the baseline glucose levels were different. And the difference at this point will affect to the glucose levels at other periods as on postprandial at 120 minutes.

Table 5. Mean differences and Percentage differences of the blood glucose level of each period and the fasting glucose levels

Blood glucose	Black non-glutinous rice Mean (SD)	Mean difference (%)	Black glutinous rice Mean (SD)	Mean difference (%)
Fasting	82.1 (6.3)		86.1 (5.1)	
Postprandial 30 min	108.5 (17.7)	26.4 (32.16)	109.3 (12.5)	23.2 (26.95)
60 min	88.2 (15.3)	6.1 (7.43)	90 (11.8)	3.9 (4.53)
120 min	77.4 (8.4)	4.7 (5.72)	83.3 (5.1)	2.8 (3.25)

The mean differences and percentage differences of both groups were similar. Moreover, the differences of black glutinous rice were even less than the black non-glutinous rice. (Table 5)

It cohered with the iAUC of glucose which there was no significant difference. (Figure 1) This statistical analysis eliminates the unequal baseline problems. And it can be described as the theory that the blood glucose levels of normal people after meal is reduced to the baseline at the 2 hours.

From the study of amylose and amylopectin content in rice (Sunee et al, 2015), glutinous rice is likely increase higher blood glucose levels than non-glutinous rice as in many studies in white rice. But the same attribute of black rice are ; High fiber content which reducing intestinal glucose absorption, so, blood glucose increases less than consuming white rice (Seki et al, 2005) and the attribute of many vitamins, minerals and antioxidants that work together in many mechanisms are called food synergy which controls blood glucose level. (Jacobs and Tapsell, 2007) It can be explained why this research shows that having both black glutinous rice and black non-glutinous rice have no different effect to blood glucose and insulin levels.

CONCLUSION

In conclusion, having black non-glutinous rice and black glutinous rice in the same amount of energy have no effect on blood glucose levels. The insulin levels were not significant difference in two groups. The iAUC of insulin of both groups were not significant difference. It can be concluded that having black non-glutinous rice and black glutinous rice in the same amount of energy have no effect to insulin levels.

RECOMMENDATIONS

1. Further studies in pre-diabetic or diabetic patients.
2. Long-term studies should be done to determine the blood glucose levels, insulin levels and other parameters of long-term consumption of rice such as HbA1c and serum lipids.
3. It should be further explore that people who mostly consume glutinous rice, and focus on how much energy that they get, more or less compared to the normal proportion should be eaten.

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