

Low Glycaemic Index Foods, a Better Option for Pre-exercise Meals.

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Abstract

Background: The glycaemic index (GI) of food ingested before exercise influences substrate utilization during exercise and may affect performance during exercise.

Aim: This study determined the impact of low(LGI) and high GI (HGI) foods on post exercise blood glucose and lactate levels.

Methods: 24 male subjects meeting defined requirements were recruited to participate in the experiment. Data from 17 individuals were finally analyzed following exclusion of ineligibility of 7 individuals. They were randomly selected into 3 groups; group 1- (Control n=5, distilled water), group 2 (n=6, 100 g of cooked brown beans), and group 3 (n=6, 100 g of white bread). Postprandial and post-exercise blood glucose level was measured by the glucose oxidase method and Blood lactate concentration was also determined. Data collected was analysed using statistical package for social sciences and results were expressed as mean and standard error of mean.

Results: A significant increase ($p<0.05$) in postprandial blood glucose level before exercise in both LGI and HGI fed groups was recorded when compared to control. After exercise, blood glucose level was significantly increased ($p<0.05$) in LGI fed group when compared to control, with a significant decrease ($p<0.05$) in blood glucose in the HGI fed group when compared to group 2. Postprandial and post-exercise lactate levels were significantly increased in both groups.

Conclusion: LGI food is capable of providing more energy (stored) which can later be utilised during later stage of a prolonged exercise, hence, consumption of such food is suggested to athletes involved in long duration exercises

Keywords: Low glycaemic index, blood glucose, lactate, exercise

Introduction

Glucose is the primary metabolite for the body source of energy in daily activities man engages in, such as walking, washing, eating, running and swimming¹. Ingestion of carbohydrate (CHO) before exercise may result in an improved exercise performance when compared with exercise in the fasting state^{2,3}.

Ingesting CHO before exercise increases the rate of utilization of this limited substrate store, and yet still delays the onset of fatigue and this increased rate of

CHO utilization is a consequence of a glucose-induced rise in plasma insulin concentration that, in turn, suppresses the rate of fatty acid oxidation^{2,4}.

The glycaemic index (GI) of food ingested before exercise influences substrate utilization during exercise and may affect performance during exercise^{5,6}. Based on glycaemic index, foods are classified into high glycaemic index food (HGI) and low glycaemic index food (LGI)⁷. It is suggested that carbohydrate feeding prior to exercise provides additional supplies for oxidation, results in increased muscle glucose uptake and reduced liver glucose output during exercise, and the enhanced blood glucose availability may preserve muscle glycogen stores^{8,9}. After taking a meal, digestion

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and absorption occurs and of the absorbed component is glucose. Glucose enters the glycolytic pathway; a series of enzymatic reaction occurs and is metabolized into pyruvate which enters the citric acid cycle for ATP (energy) generation¹⁰.

Carbohydrates (CHOs) in the form of muscle and liver glycogen, and plasma glucose are a limited source of energy in the body, while there are comparatively limitless amounts of stored fatty acids¹¹. Depletion of body CHO is associated with a lowering of blood glucose and the onset of fatigue.

Ingestion of food before exercise may result in an improved exercise performance when compared with exercise in the fasting state^{2,12}. Studies by Thomas *et al.*³, show that slow digesting carbohydrate food of low glycaemic index eaten before prolonged strenuous exercise increases the blood glucose concentration toward the end of the exercise

This study was therefore carried out to relate the effect of the consumption of high glycaemic index food (bread), and a low glycemic index food (beans) on blood glucose and lactate level. Findings from this study can be used to identify which would better improve the performance of athletes during endurance exercise, especially in developing countries where CHO foods abound.

Material and Methods

Test Subjects

24 male subjects (all students of the University of Ilorin, Ilorin, Nigeria) aged between 19-23 years were recruited to participate in the experiment. Persons using insulin or other diabetic drugs were excluded to minimize potential confounding from hypoglycemic medications. All participants were physician-certified medically fit and had no history suggestive of any chronic illnesses or condition(s) that would influence their ability to complete the study as determined from medical record analysis. Persons with a history of diabetes mellitus, cardiorespiratory dysfunction or smoking and allergy to beans were also excluded during the screening process. This study was approved by the University Institutional Review Board, and all participants provided written, informed consent. Twenty-two successfully completed the experiment in its entirety. Three participants were excluded from final analysis. Two of the latter participants did not fully disclose medical conditions

until after they started the study and were ineligible. Data from 17 individuals were analyzed.

Preparation of Test Food

The two test foods, beans (brown beans) and white bread are obtained from Kulende, Market, Ilorin, Kwara State, Nigeria. The beans were picked to separate the shaft from the seeds. It was rinsed to separate it from other impurities. It was then cooked in a clean pot of water with an electric cooker for 40 minutes till almost all the water vaporized and the beans was soft and palatable.

Grouping

The 17 students used for the test were randomly selected into 3 groups; group 1- (Control n=5) were administered distilled water, group 2 (n=6) were administered 100 g of cooked brown beans, and group 3 (n=6) were administered 100 g of white bread. Prior to the test day, all subjects were fasted overnight

Experimental Procedure

The postprandial blood glucose level was measured 2 hours after the administration of the test foods, which was done under researcher supervision, and so also was blood collected for lactate analysis. After the collection of blood, the subjects waited for 3 minutes before proceeding to the exercise on the treadmill moving at 5km/hr and the bicycle ergometer for 20 minutes non-stop. After the exercise, blood glucose level was again measured and blood sample was again taken for lactate analysis.

Blood Sample Collection

All blood samples were collected into the heparinized tube. The blood was collected from a prominent dorsal vein of the palm with a 5mL syringe. Tourniquet was tight to the wrist to increase the pressure of blood flowing to the. Methylated spirit and cotton wool was used to clean the area in which the blood was collected from before the syringe needle was inserted and the blood was drawn into the syringe and ejected into the heparinized tube.

Determination of Blood Lactate and Glucose level

Postprandial and post-exercise blood glucose level was measured by the glucose oxidase method using a Accu check glucometer (Accu check, Roche, USA). Blood lactate concentration was determined using a Lactate Pro lactate analyzer (Arkray, Inc., Kyoto, Japan).

Statistical Analysis

Data collected were analysed using statistical package social sciences (SPSS) version 21. The blood glucose and lactate level were expressed as a mean $\pm$ standard error of mean (SEM). Two-way ANOVA was used to compare the means among the groups, followed by a t-test between individual groups. Differences were considered to be statistically significant at $p < 0.05$.

Results

The blood glucose level in control and experimental rats is shown in table 1. There was a significant increase in blood glucose level before exercise in LGI group (100 g brown beans) 6.450 ± 0.32 $p = 0.0043$ and HGI group (100 g white bread) 6.600 ± 0.29 $p = 0.0007$ when compared to control (distilled water) 3.950 ± 0.21 . After exercise, blood glucose level was significantly increased in LGI group (4.600 ± 0.36 $p = 0.003$) when compared to control (2.200 ± 0.12). A significant decrease was recorded when HGI group (2.400 ± 0.30 $p = 0.003$) was compared to LGI group.

Table 1: Blood glucose level in control and experimental rats before and after exercise

Groups	Control (distilled water)	100 g Brown beans	100 g White bread
Blood glucose mMol/L) before exercise	3.950 ± 0.2 1	6.450 ± 0.3 2*	6.600 ± 0.2 3*
Blood glucose mMol/L) after exercise	2.200 ± 0.1 2	4.600 ± 0.3 6*	2.400 ± 0.3 0**

* shows statistical significance at $p \leq 0.05$ when compared to Control group

** shows statistical significance at $p \leq 0.05$ when compared to group 2 (100 g brown beans)

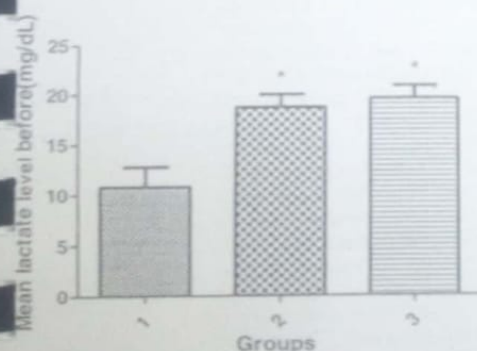


Figure 1: A graph showing the mean blood lactate level before exercise after the consumption of the test foods. *

shows statistical significance at $p \leq 0.05$ when compared to group 1

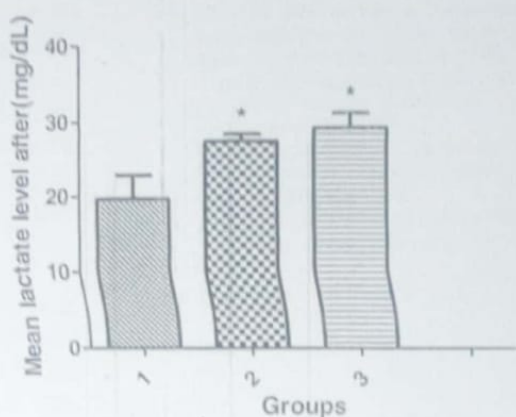


Figure 2: A graph showing the mean blood lactate level after exercise after the consumption of the test foods. * shows statistical significant at $p \leq 0.05$ when compared with group 1

Blood lactate level before exercise (figure 1) was 10.78 ± 1.980 , 18.735 ± 1.272 $p = 0.007$ and 19.610 ± 1.299 $p = 0.014$, in control group (distilled water), LGI group (100 g brown beans) and HGI group (100 g white bread), respectively. While after exercise (figure 2), it was 19.673 ± 3.156 in group 1 and 24.546 ± 2.026 $p = 0.008$ and 29.092 ± 1.987 $p = 0.005$ in the LGI and HGI groups, respectively.

Discussion

This study was carried out to determine the effect of pre-exercise LGI and HGI foods on blood glucose and lactate level with the aim of proposing which of the two would serve as a better meal before exercise/ sporting activities. A significant ($p < 0.05$) increase in the blood glucose level was recorded in the both experimental groups when compared to the control group. This corresponds to findings by Ching-Lin and Clyde², who demonstrated that plasma glucose concentrations increased sharply in human subjects following ingestion of HGI and LGI meals.

There was a significant ($p < 0.05$) increase in the blood glucose level of LGI fed group after exercise. Whereas, the increase in blood glucose level of the HGI fed group after exercise was insignificant ($p > 0.05$) when compared to the control group. Comparing the blood glucose

before and after exercise it was found that the blood glucose decreases after the completion of the exercise, with an observed significant decrease ($p < 0.05$) in the HGI fed group when compared to the LGI fed group. The observed reduction in the post exercise blood glucose level can be due to the huge amount of glucose absorbed from the HGI food whereas, the LGI food gives a steady glucose supply which can last long before exhaustion sets in. This suggests that consumption of LGI foods provides the body with a steady supply of glucose and still leaves the subjects with a considerably high amount of glucose after exercise.

The study also showed that consumption of both foods yielded a significant ($p < 0.05$) increase in lactic acid levels (pre-exercise and post exercise) in both LGI and HGI fed groups when compared to control. This corresponds to studies by Ching-Lin and Clyde² who reported that blood lactate concentrations increased significantly after ingestion of the LGI meal.

Conclusion

This study shows that LGI food is capable of providing more energy (stored) which can later be utilised during later stage of a prolonged exercise, hence, consumption of such food is suggested to athletes involved in long duration exercises. However, this should not be in contrary to medical prescriptions.

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