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Research Article

THE EFFECTS OF A NOVELTY LOW GLYCEMIC DRINK ON NON-FASTING BLOOD GLUCOSE RESPONSE IN TYPE 2 DIABETIC RATS

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ABSTRACT

Background: This study was done to determine the effects of a low glycemic index drink (LGI) on non-fasting blood glucose levels in type 2 diabetic (T2D) rats. Diabetes management has been associated with foods that has a low glycemic response as research has shown that it improves the condition. Nutrition therapy has been one of the first option of treatment for the prevention and management of T2D. Foods with carbohydrates that are slowly metabolized, digested and absorbed, have been linked with reducing the risk of T2D by improving insulin sensitivity as well as lowering blood glucose fluctuations. By developing and assessing the impact of a LGI drink in type 2 diabetic rats, a healthy and therapeutic nutritional option can be available to diabetics on the local market, further aiding in the management of T2D.

Methods: For a gender unbiased research, both male and female streptozotocin induced T2D Sprague-Dawley rats (32 each) weighing 195.5±27.7g were assessed, with and without the LGI drink. Non-fasting blood glucose levels were measured in the blood collected from the tail, once weekly for twelve (12) weeks using a portable glucometer (Glucolab Blood Glucose Monitoring System).

Results: Results showed that there was a significant ($p<0.05$) and consistent reduction of non-fasting blood glucose levels (NFBG) over the experimental period for the diabetic group that were fed LGI drink; with average blood glucose levels for the final month being 6.75±0.79 mmol/L as compared to the diabetic rats (control) which averaged blood glucose levels of 31.39 ± 3.94 mmol/L. Results were compared to known goal blood glucose levels for diabetics of normo-glycemic levels of 4.0-7.7 mmol/L.

Conclusion: This low GI drink may be useful for type 2 diabetic patients that are seeking a healthy alternative to the high carbohydrate beverages currently available in Jamaica as it lowered NFBG levels in type 2 diabetic group to that of normo- glycaemic levels 4.0-7.7 mmol/L. The availability of a LGI drink on the Jamaican market may aid in the maintenance and management of T2D.

INTRODUCTION

The glycemic index was initially used as a means of classifying different foods based on their effect on postprandial glycaemia (Brouns *et al*., 2005). Research done by the Clinical Nutrition Research Unit in Uppsala University, Sweden, showed that a diet characterized by low glycemic index (LGI) starchy foods lowers the glucose and insulin responses, suggesting a therapeutic potential in diabetes (Järvi *et al*., 1999). The consumption of LGI diet lowers blood glucose level and can be used as an inexpensive method of managing diabetes (Ludwig, 2002).

The glycemic index simply measures how much a 50-gram portion of a carbohydrate can raise blood sugar levels in comparison to pure glucose that has a glycemic index score of 100. The glycemic index was initially used as a means of classifying different foods based on their effect on postprandial glycaemia (Brouns *et al*., 2005). By using this relationship researchers have come up with ranges in which foods can be classified based on their GI. Foods that score higher than 70 are considered high GI foods while those that score 55 and under are considered low-GI foods (Cichon *et al*., 2011) (Reffetto, 2014). The glycemic index is a powerful and practical aid for diabetics as well as non-diabetics who wish to manage their blood glucose levels. Diabetes management has been associated with foods with low glycemic response as research has shown that it improves blood lipids which cause high cholesterol levels and thus reduces the risk of obtaining heart disease, and even weight management (Rock *et al*., 2014). Nutrition therapy has been one of the first option of treatment for the prevention and management of type 2 diabetes by many. Foods with carbohydrates that are slowly metabolized, digested and absorbed, and have been linked with reducing the risk of type 2 diabetes by improving insulin sensitivity as well as the

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concentrations of glycated hemoglobin (Marsh *et al*., 2011). Low-carbohydrate diets are oftentimes used to initiate weight loss in obese people as well as a combined diet of lower glycemic index carbohydrates and higher protein which is proved to be the most successful diet for the avoidance of regaining weight (Foster *et al*., 2003) (Fabbrini *et al*., 2012) (Brand-Miller *et al*., 2012). It is therefore quite evident that a low glycemic index diet can have a significant positive impact on a type 2 diabetic individual. Research done by the Clinical Nutrition Research Unit in Uppsala University in Sweden, showed that a low-GI diet lowers the glucose and insulin responses, thus suggesting a therapeutic potential in diabetes (Järvi *et al*., 1999). Another research done at the Human Nutrition Unit, School of Molecular and Microbial Biosciences at University of Sydney, showed that a low-GI diet reduced glycated hemoglobin by 0.43% more than that high-GI diets concluding that low-GI foods has a minute but helpful effect on glycemic control in diabetic patients (Brand-Miller *et al*., 2003) and backing the findings of previously mentioned was research done by Marsh *et al*., 2011. Low GI diet lowers blood glucose level and can be used as an inexpensive method of managing DM and for this reason is becoming quite popular as an alternative to the medications available (Ludwig, 2002). Contradictory, studies carried out by Kristo *et al*., 2013, concluded that in comparing low and high GI diets via measures of blood lipids, glucose homeostasis, and inflammation showed inconsistency in results; suggesting that the use of low GI foods use in the formulation of dietary recommendations is premature (Kristo *et al*., 2013).

Convenient foods are becoming more sought after as individuals are having less time to prepare a healthy meal due to their busy lifestyles. Over the past years there has been an increase in demand for not only fast foods but also supplemented drinks, especially for persons suffering from nutritional deficiencies or comorbid diseases such as diabetes. This study was conducted to aid in the development of a LGI drink and make it commercially available to the diabetic population.

MATERIALS AND METHODS

Study Population

Sprague-Dawley rats weighing 150-250g at 90 days of age were obtained from the Animal House of the University of the West Indies.

Design of experiment

Sprague-Dawley rats weighing 150-250g at 90 days of age were obtained from the Animal House of the University of the West Indies. Animals were housed in stainless steel cages, which were cleaned daily and under a 12/12-hour light/dark cycles with rats having free access to food and water. A modified version of previously used protocol for Fructose-fed streptozotocin-injected rat model for type 2 diabetes; Wilson *et al*, 2012 was used to induce type 2 diabetes in rats. Rats were fed with rat pellets and 10 % fructose solution in place of water for the initial 2 weeks after which rats were intravenously administered 40 mg/kg BW streptozotocin (STZ) of concentration 15 mg/ml in a citrate buffer of pH 4.4. Rats were fed normal drinking water for reminding of experiment. Animals with non-fasting blood glucose (NFBG) level > 16 mmol/L one (1) week after STZ injection were considered as diabetic.

Rats were divided into four (4) groups each having 4 males and 4 females; T2D rats fed the LGI drink (DL); Non-diabetic rats fed the LGI drink (NL); T2D rats control (D) and Non-diabetic rats control (N). Based on the daily requirements for Glucerna diabetic drink, each rat was given 12 ml of the LGI drink daily in groups DL and NL which was drank in its entirety after which, the normal diet of Formulab Diet rat food (purchased from OK Feed Store, Miami, FL., U.S.A) and water was resumed.

NFBG levels were measured in the blood collected from tail, once weekly for twelve (12) weeks using a portable glucometer (Glucolab Blood Glucose Monitoring System). Animals were sacrificed after experimental period using Sodium Pentobarbital 100 or > mg/kg IV as euthanasia agent and blood and organ samples collected for further biochemical, physiological and morphological testing.

Ethical Approval

Animals were maintained in accordance to the rules and regulations of the University of the West Indies, Mona Animal Ethics Committee (Ethical approval number: AN 17,13/14).

Test food

Vegetable drink consisted of beetroot (*Beta vulgaris*) 2%, cucumber – (*Cucumis sativus*) 6%, and carrot (*Daucus carota*) 25% as main ingredients. The glycemic index was previously determined prior experiment. Proximate analysis for carbohydrate, fat, crude protein, moisture, dietary fiber content and ash were determined using the AOAC (2002) standard. Total carbohydrate was done by difference according to FAO/WHO Expert Consultation protocol (Food and Agriculture Organization & World Health Organization, 1998).

Statistical Analysis

Statistical analysis was performed using GraphPad Prism version 6. Data obtained from the experiments are expressed as mean ± SE. Values of $p \leq 0.05$ were considered significant using *One Way Anova* test.

RESULTS

Results showed that there was a significant ($p \leq 0.05$) and consistent reduction of non-fasting blood glucose (NFBG) levels over the experimental period for diabetic groups that were under the were fed the low GI drink with average blood glucose levels for the final month being 6.75 ± 0.79 mmol/L as compared to the non-treated diabetic rats (control) which averaged blood glucose levels of 31.39 ± 3.94 mmol/L (Fig 1) (Table 1).

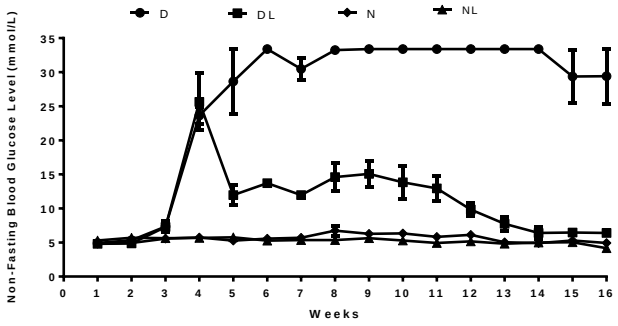

Fig. 1. Mean non- fasting blood glucose concentration. D- Diabetic rats fed normal rat diet; DL- Diabetic rats on low glycemic index drink; N- Non-Diabetic rats fed normal rat diet; NL- Non-Diabetic rats fed low glycemic index drink. Data are shown as the mean ± standard error of the mean.

Table 1 Initial and final non-fasting blood glucose levels

Groups	Initial Non-Fasting Blood Glucose (mmol/L)	Final Non-Fasting Blood Glucose (mmol/L)
D	23.62 ± 1.19 [a]	29.40 ± 4.00 [a]
DL	25.63 ± 4.20 [a]	6.40 ± 0.06 [b]
N	5.73 ± 0.56 [b]	4.93 ± 0.44 [b]
NL	5.67 ± 0.28 [b]	4.17 ± 0.35 [b]

D- Diabetic rats fed normal rat diet; DL- Diabetic rats on low glycaemic index drink; N- Non-Diabetic rats fed normal rat diet; NL- Non-Diabetic rats fed low glycaemic index drink. Data are shown as the mean ± standard error of the mean. Figures in vertical columns with different superscripts are significantly different; $p \leq 0.05$ *One Way ANOVA* test.

DISCUSSION

All non-diabetic animals had a significantly lower ($p \leq 0.05$) glucose level over the three (3) month period when compared to the diabetic irrespective of the treatment (table 1). This was expected as type 2 diabetes is a metabolic disorder that is characterized by high blood glucose in the context of insulin resistance and relative insulin deficiency (Kumar *et al*., 2005) (Khardori, 2013). The diabetic animals would therefore have insulin resistance thus would be unable to lower blood sugar. Untreated diabetic rats (D) had the highest NFBG levels over the experimental period as expected as untreated type 2 diabetes can lead to several complications, such as damages to vital organs and even ketoacidosis which causes uncontrollable NFBG levels (Kumar *et al*., 2005) (Khardori, 2013). The diabetic rats which were fed the low GI drink (DL) maintained a consistent glucose level over the experimental time frame with a significant reduction ($p \leq 0.05$) by week 16 as seen in Fig. 1. This was expected as a low GI diet release glucose slower than medium and high GI foods. Carbohydrates that are broken down and absorbed quickly during digestion and release glucose rapidly into the bloodstream are referred to as high glycemic index while those that break down more slowly and release glucose moderately into the bloodstream have a low glycemic index and that which releases glucose at an intermediate rate into the blood stream is considered to have a medium glycemic index (Ludwig, 2002) (Brand-Miller *et al*., 2002) (Cichon *et al*., 2011) (Reffetto, 2014). Within the first week of treatment the DL group had a significant ($p \leq 0.05$) reduction in NFBG level which trended towards a normo-glycemic condition (Fig 1.). From this result it can be concluded that the LGI drink can aid in the management and maintenance of the NFBG levels in T2D.

CONCLUSION

This low GI drink may be useful for type 2 diabetic patients that are seeking a healthy alternative to the high carbohydrate beverages currently available in Jamaica as it lowered NFBG levels in type 2 diabetic group to that of normo- glycaemic levels 4.0-7.7 mmol/L. The availability of a LGI drink on the Jamaican market may aid in the maintenance and management of T2D.

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References

1. Brand -Miller, J. & Buyken, A. E. (2012). The glycaemic index issue. *Current Opinion in Lipidology*, 23 (1), 62-67.
2. Brand -Miller, J., Hayne, S., Petocz, P. & Colagiuri, S. (2003). Low--glycaemic index diets in the management of diabetes a meta-analysis of randomized controlled trials. *Diabetes Care*, 26 (8), 2261-2267.
3. Brand-Miller, J., Holt, S., Pawlak, D., & McMillan, J. (2002). Glycemic Index and Obesity. *American Journal for Clinical Nutrition*, 76, 281-285.
4. Brouns, F., Bjorck, I., Frayn, K. N., Gibbs, A. L., Lang, V., & Wolever, T. M. S. (2005). Glycemic index methodology. *Nutrition Research Reviews*, *18*(1), 145-171.
5. Cichon R, Wądołowska L. (2011). Carbohydrates. Human Nutrition. The basics of nutrition science. Gawęcki J(Ed.). PWN, Warsaw,155-77.
6. Food and Agriculture Organization – FAO, World Health Organization – WHO. (1998). Carbohydrates in human nutrition. Geneva.
7. Foster-Powell, K., Holt, S. H., & Brand-Miller, J. C. (2002). International table of glycemic index and glycemic load values: 2002. *The American journal of clinical nutrition*, *76*(1), 5-56.
8. Fabbrini, E., Higgins, P. B., Magkos, F., Bastarrachea, R. A., Voruganti, V. S., Comuzzie, A. G., Shade, R. E., Gastaldelli, A., Horton, J. D., Omodei, D. & Others. (2013). Metabolic response to high-carbohydrate and low-carbohydrate meals in a nonhuman primate model. *Am J Physiol Endocrinol Metab*, 304 (4), 444-451.
9. Järvi, A. E., Karlström, B. E., Granfeldt, Y. E. (1999). Improved glycemic control and lipid profile and normalized fibrinolytic activity on a low-glycemic index diet in type 2 diabetic patients. Clinical Nutrition Research Unit, Uppsala University, Sweden.
10. Khardori, R. (2013). Type 2 Diabetes Mellitus. Strelitz Diabetes and Endocrine Disorders Institute, Department of Internal Medicine, Eastern Virginia Medical School.
11. Kristo, A., Matthan, N. R. & Lichtenstein, A. H. (2013). Effect of diets differing in glycaemic index and glycemic load on cardiovascular risk factors: review of randomized controlled-feeding trials. *Nutrients, 5* (4), 1071-1080.
12. Kumar, V., Fausto, N., Abbas, A.K., Cotran, R.S., Robbins, S.L. (2005). *Robbins and Cotran Pathologic Basis of Disease* (7th ed.). Philadelphia, Pa.: Saunders, 1194–1195.
13. Ludwig, D.S. (2002). The glycemic index: physiological mechanisms relating to obesity, diabetes, and cardiovascular disease. Retrieved on March 21, 2013 from http://www.ncbi.nlm.nih.gov/pubmed/11988062
14. Marsh, K., Barclay, A., Colagiuri, S., Br & -Miller, J. (2011). Glycemic index and glycemic load of carbohydrates in the diabetes diet. *Current Diabetes Reports*, 11 (2), pp. 120--127.
15. Raffetto, M. (2010). *The glycaemic index diet for dummies*.
16. Rock C.L., Flatt S.W., Pakiz B., Taylor K.S., Leone A.F., Brelje K., Heath D.D., (...), Sherwood N.E. (2014). Weight loss, glycemic control, and cardiovascular

disease risk factors in response to differential diet composition in a weight loss program in type 2 diabetes: A randomized controlled trial. *Diabetes Care*, 37 (6), pp. 1573-1580.

17. Wilson R.D. & Islam S. (2012). Fructose-fed streptozotocin-injected rat: an alternative model for type 2 diabetes. Pharmacological Reports, 64 (129139), 1734-1140.

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