Effect of Partial Substitution of Wheat Flour with a Flour Blend of Okra, Lentils, Barley and Fenugreek, on the Glycemic Index of Commonly Consumed Starchy Foods

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ABSTRACT

Objectives: A flour blend consisting of okra, lentils, barley and fenugreek was developed with the aim to reduce the rate of glucose absorption from flour used in processed starchy foods. The objective of this study was to measure the glycemic index (GI) of a range of commonly consumed starchy foods in which wheat flour was partially substituted with the plant based flour blend.

Methods: Four different starchy foods containing the blend (Holista™ GILiTE) were tested: a muffin, a breakfast cookie, noodles, and bread. The GI was determined using the standard ISO 26642:2010 method for GI determination. Healthy male or female subjects aged 18-75 years with a BMI less than 35kg/m^2 were recruited. Each test meal contained 25 or 50g available carbohydrate. Capillary blood samples for blood glucose analysis were taken at -5, 0, 15, 30, 45, 60, 90 and 120 minutes. Each subject consumed the test food once and the carbohydrate matched reference food at least two times to allow calculation of the GI. Palatability was assessed using a visual analogue scale.

Results: A total of 23 participants were recruited (12M:11F; 45 ± 14yrs; 28. 3 ± 5. 5 kg/m2). Each food was tested by 10 participants and each participant consumed at least 1 test food and 2 reference foods at GI Labs. The GI of the muffin, cookie, noodles and bread were 48±2, 52±3, 38±4 and 66±8 respectively. All foods were well tolerated. The palatability scores were not statistically significantly different from the white bread control but were significantly higher than the dextrose control (p<0. 05).

Conclusions: Partial substitution of wheat flour with a flour blend of okra, barley, lentils and fenugreek resulted in 3 of the products falling into the low GI category; the exception was the bread which fell into the medium GI category. Further research needs to be undertaken to determine the extent of the reduction in GI achieved by the blend.

INTRODUCTION

The World Health Organization estimates that high blood glucose is the third highest risk factor for premature mortality (WHO, 2009). As the prevalence of impaired glucose tolerance and diabetes is increasing exponentially and is currently an estimated 13% prevalence worldwide (Glen D, 2003), this is cause for grave concern.

At the same time obesity rates have also been climbing at epidemic rates (GBD Obesity Collaborators, 2017). Changes in lifestyle factors have generally been blamed for these epidemics which has resulted in a renewed focus on the extent that changes in exercise patterns and diet are responsible. The quality and quantity of carbohydrate and dietary fibre have emerged as possible loci of interest to perhaps address some of the problems. Decreasing the glycemic index of the diet has been one approach to modulate postprandial glucose levels (Porter-Rockwell B, 2010). Recently Holista has developed a plant based flour blend (Holista™ GILiTE) consisting of a mixture of okra, lentil, barley and fenugreek. This high fibre mixture is intended to be used as a partial substitute for regular flour resulting in foods which are higher in fibre and will attenuate postprandial blood glucose levels. To test this hypothesis, this study determined the glycemic index of 4 foods which were developed using the flour blend: a muffin, a bread, noodles and a cookie.

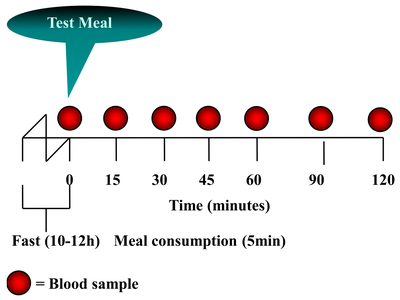
METHODS

Participant Characteristics

Participant Characteristics	All subjects (n=23)
Age	45 ± 14y
Gender	12M,11F
BMI	28.3 ± 5.5 kg/m^2
Fasting Blood Glucose	4.52 ± 0.06 mmol/L

Design

Acute, randomized cross-over study which followed the methodology as specified in ISO 26642:2010 "Food products - Determination of the glycaemic index (GI) and recommendation for food classification"



Test Meals

Each food was tested by 10 participants and each participant consumed at least 1 test food and 2 reference foods (dextrose or white bread). Test foods consisted of either a muffin, cookie, noodles or bread in which part of the flour had been substituted with the okra, barley, lentil and fenugreek flour blend. Each subject was given a choice of a beverage to consume with the test meal; the beverage chosen was kept the same for all test meals.

Macronutrients

Test Meal	Weight (g)	Energy (kcal)	Protein (g)	Fat (g)	Total CHO (g)	Fibre (g)	Avail CHO (g)
Dextrose Control	54.9	200	0	0	50	0	50
Lite Foods White Bread	117.5	258	9.5	3.1	55.2	5.2	50.0
Muffin	108.2	346	5.0	14.0	52.5	2.5	50.0
Cookie	111.5	267	9.5	3.2	55.2	5.2	50.0
White Bread Control	56	119	4.1	0.3	27.1	1.3	25
Low GI Noodles	37.3	127	4.8	0.9	26.3	1.3	25

RESULTS

Glycemic Index

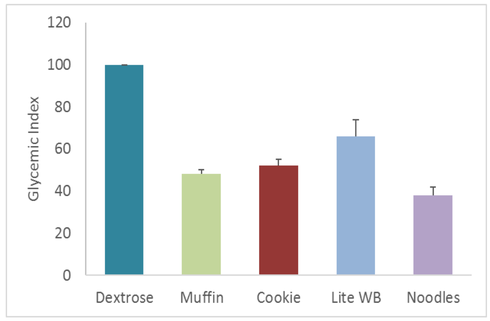


Figure 1: Glycemic Index of the Dextrose and 4 foods containing GI LITE: Blueberry Muffin, Breakfast Cookie, Lite White Bread and Noodles. Results are expressed as Mean±SEM

Test Meal	Pal (mm)	IAUC (mmol/L.min)	GI	GI Category
Dextrose Control	50±10^a	229.8±21.7^a	100^a	High
Lite Foods White Bread	77±6^b	153.8±22.6^b	66±8^b	Medium
Muffin	87±2^b	118.6±14.6^b	48±2^c	Low
Cookie	77±4^b	124.6±14.1^b	52±3b^c	Low
White Bread Control	69±6^a	127.2±10.9^a	71^a	High
Low GI Noodles	66±8^a	66.1±7.9^b	38±4^b	Low

Table 3: Palatability ratings, glucose IAUC, glycemic index (GI) and GI category for 4 different test meals with their respective controls (Dextrose or White Bread). Results are expressed as Mean±SEM, numbers within each series with a different letter are statistically significantly different (p<0.05)

Blood Glucose

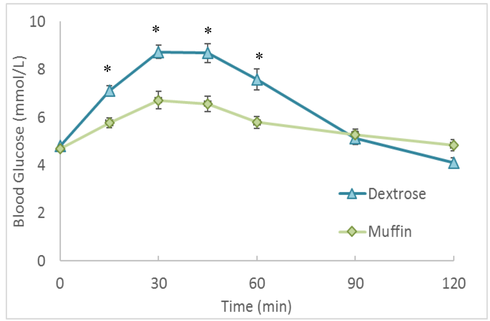


Figure 2: Postprandial blood glucose measurements after a Dextrose Control and a Blueberry Muffin in which part of the flour has been substituted with a okra, barley, lentil and fenugreek flour blend. All meals contained 50g available carbohydrate. Results are expressed as Mean±SEM, and using ANOVA for main effects of time and test meal and the time×meal interaction. *(p<0.05)

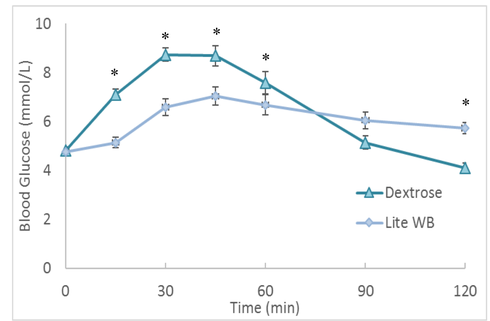


Figure 4: Postprandial blood glucose measurements after a Dextrose Control and Lite White Bread in which part of the flour has been substituted with a okra, barley, lentil and fenugreek flour blend. All meals contained 50g available carbohydrate. Results are expressed as Mean±SEM, and using ANOVA for main effects of time and test meal and the time×meal interaction. *(p<0.05)

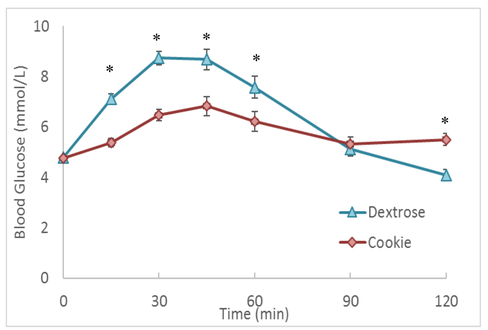


Figure 3: Postprandial blood glucose measurements after a Dextrose Control and a Breakfast Cookie Bread in which part of the flour has been substituted with a okra, barley, lentil and fenugreek flour blend. All meals contained 50g available carbohydrate. Results are expressed as Mean±SEM, and using ANOVA for main effects of time and test meal and the time×meal interaction. *(p<0.05)

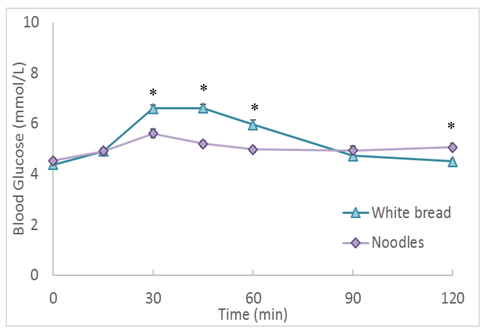


Figure 5: Postprandial blood glucose measurements after a White Bread Control and Noodles in which part of the flour has been substituted with a okra, barley, lentil and fenugreek flour blend. All meals contained 25g available carbohydrate. Results are expressed as Mean±SEM, and using ANOVA for main effects of time and test meal and the time×meal interaction. *(p<0.05)

CONCLUSIONS

The Glycemic Index values of the GILiTE containing foods was significantly lower than the Dextrose or White Bread Control (p<0.05)

Partial substitution of wheat flour with a flour blend of okra, barley, lentils and fenugreek resulted in 3 of the products falling into the low GI category; the exception was the bread which fell into the medium GI category.

All foods were well tolerated. The palatability scores were equal or higher than bread and were significantly higher than the dextrose control (p<0.05).

Further research needs to be undertaken to determine the extent of the reduction in GI achieved by the blend.

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holista foods

HOLISTA COLLTECH

Clinical Trial Carried out by:

GI Labs