Effect of Egyptian Bread Prepared by Different Types of Flour on Diabetic Rats and Its Glycemic Index in Diabetic Patients

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Abstract: The blood glucose response to a food is not accurately predicted by the content of available carbohydrate in the food. Also Glycemic index (GI) is a useful index to describe the extent to which certain food can increase the blood glucose in human. The present study was carried out to estimate the effect of Egyptian bread prepared by different types of flour on diabetic rats and it's glycemic index in diabetic patients. Seven different types of bread were examined which prepared by different mixture of flours (wheat, corn and rice). A total of 45 male healthy rats, weighing between (140-150gm) were divided into 9 groups.all rats were subcutaneous injected by alloxan as 150 mg/kg body weight rats to induce hyperglycemic except rats of negative control. The negative control and positive control groups (1 and 2) fed on basal diet without treatment, all diabetic treated groups (1- 9) fed on basal diet containing deferent type of bread as a source of carbohydrates. Then samples were collected to examine serum glucose and lipids profile. In addition the present human study was conducted among 50 diabetic out patients attending Six October Hospital was assessed by measured height, weight, age, body mass index, as well as blood analysis of glucose by One Touch USA.For all patients Blood glucose were estimated as fasting and after 2 hours from eating 50 g carbohydrates of different types of bread, and also blood glucose were estimated as fasting and after 2 hours from eating 50 g of glucose, to calculate glycemic index. The observed results revealed a significant ($p \leq 0.05$) decrease in serum glucose and lipids profile (total lipids, total cholesterol, triglycerides, LDL-c and VLDL-c) and also significant ($p \leq 0.05$) increase in HDL-c were observed for all diabetic groups fed on diets containing different types of bread comparing with diabetic rats fed on basal diet (control positive). The best results were found in group which fed on bread (whole wheat + whole corn + white rice flour 1:1:1), followed by group which fed on bread (whole wheat flour 100%). Moreover, the lowest values of glycaemic index (61 ± 7.00) were showed for bread (whole wheat + whole corn + white rice flour 1:1:1) followed by groups which fed on bread (whole wheat + white rice flour 1:1) and (whole wheat flour 100%) (63 ± 6.00) and (64 ± 7.00) in diabetic II respectively.In conclusion, using of breads had low-GI carbohydrates would be beneficial to patients with type 2 diabetes.

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1. Introduction

It is increasingly accepted that the blood glucose response to a food is not accurately predicted by the content of available carbohydrate in the food, as measured in traditional food analysis. At the same time, the need for food values that will complement available carbohydrate values, to enable dietary control of postprandial glycemic responses, has become recognized ***(Seidell, 2000)***. Type 2 diabetes, formerly known as non-insulin-dependent diabetes (NIDDM), accounts for most cases of diabetes mellitus worldwide. It is estimated that in 2000 there were approximately 150 million individuals with the disease and that this number is likely to double by 2025 ***(King, et al., 1998).*** Type 2 diabetes is the fourth or fifth leading cause of death in most developed countries and there is growing evidence that it has reached epidemic proportions in many developing and newly industrialized countries ***(King, et al., 1998)***. The lowest rates of type 2 diabetes are found in rural communities where people retain traditional lifestyles (***Amos, et al., 1997)***.

Accordingly, in 2004 the American Association of Cereal Chemists (AACC) established an ad hoc committee on the definition of glycemic carbohydrates charged with the task of providing "a measurable definition that will enable manufacturers to communicate the glycemic response in grams per serving of food." After lengthy and stimulating discussion, the committee proposed several recommendations and definitions, including, "Glycemic impact is the weight of glucose that would induce a glycemic response equivalent to that induced by a given amount of food"***(Miller-Jones, 2007)***. This is a simple but profound definition. It has important implications for the meaning of terminology surrounding the glycemic potency of foods, for the way glycemic potency is measured, for the management of data arising from the measurements, and for ways it can be used in

controlling postprandial glycemia. Although the AACC definition of Glycemic impact is simple, it requires a change in thinking, from food carbohydrates to entire foods, and from static index values to intake-sensitive values, and from unit-free values to nutrient-like values that represent glycemic effects with weight units ***(Monro.2006).***

Studies carried out in people with diabetes shed further light on the possible roles of dietary fiber and GI. Many studies have shown that glycaemic control is improved and the total LDL cholesterol reduced on relatively high carbohydrate, low fat diets including naturally occurring fiber-rich foods compared with relatively low carbohydrate, higher fat diets. A similar benefit has also been shown when comparing diets with similar carbohydrate: fat ratios, but with the experimental diet being appreciably higher in fiber. Feeding supplements of dietary fiber for several weeks has also been shown to lower both post-prandial glycemia, insulin levels ***(McIntosch and Miller (2001) and Anderson (1986).*** Numerous studies have illustrated beneficial effects of a diet comprising foods with a low GI in type 2 diabetics ***Frost et al.,(1994).*** Furthermore, some studies have found that foods with a high GI increase fasting triacylglycerol concentrations, even when the amount of carbohydrate is kept constant ***Brand-Mille (1994).***

Some studies have a significant results in vitro and different results in vivo, thus this study was carried out to estimate the effect of Egyptian bread prepared by different types of flour on diabetic rats and it's glycemic index in diabetic patients.

2. Materials and Methods:

Grains:

Grains (wheat, corn and rice) used in this research was obtained from local market, Cairo, Egypt.

Alloxan:

Alloxan used was obtained from Hoffman La'roch Company. Alloxan has been used to produce diabetes in experimental animals by destroying the insulin-secreting islet cells of the pancreas. ***Malekinejad, et l.,(2012).*** All the kits used were obtained from Al-Gomhoria company, Egypt.

Preparation of bread:

Type (1): Egyptian commercial bread form local bakeshop.(72% exertion wheat flour 100%)
Type (2): whole wheat flour 100%.
Type (3): whole corn flour 100%.
Type (4): whole wheat flour and whole corn flour by (1:1).
Type (5): whole wheat flour and white rice flour by (1:1).
Type (6): whole corn flour and white rice flour by (1:1).
Type (7): whole corn flour and whole corn flour and white rice (1:1:1).

Grains (wheat, corn and rice) were ground, mix as the previous types, knead by water and baked in oven at 260 ºc to 400 ºc.

Preparation of diet.

The basal diet consisted of protein (13%), fat (4%), salt mixture (3.5%), vitamin mixture (1%), choline (0.2%), cellulose (5%) and the remainder was starch ***Reevese et al,. (1993).***

Experimental animal design:

A total of 45 male healthy rats, weighing between (140-150gm) were divided into 9 equal groups.all rats were subcutaneous injected by alloxan as 150 mg/kg body weight rats to induce hyperglycemic except rats of negative control. the experimental animals were under the normal laboratory condition in Home Economics College, Helwan Univ.. Animal, groups were as follows:

1. Fed on basal diet as a "negative control"
2. Fed on basal diet as a diabetic rats without treated "positive control "
3. Fed on basal diet (diabetic rats) containing type (1) of bread as a source of carbohydrates.
4. Fed on basal diet (diabetic rats) containing type (2) of bread as a source of carbohydrates.
5. Fed on basal diet (diabetic rats) containing type (3) of bread as a source of carbohydrates.
6. Fed on basal diet (diabetic rats) containing type (4) of bread as a source of carbohydrates.
7. Fed on basal diet (diabetic rats) containing type (5) of bread as a source of carbohydrates.
8. Fed on basal diet (diabetic rats) containing type (6) of bread as a source of carbohydrates.
9. Fed on basal diet (diabetic rats) containing type (7) of bread as a source of carbohydrates.

Blood sampling.

At the end of experiment rats were starved for 12 hr., then sacrificed under ether anesthesia. Blood samples were collected from the aortic vein into clean dry centrifuge tubes and were stored at room temperature for 15 min, put into a refrigerator for 2 hr, then centrifuged for 10 min at 3000 rpm to separate serum. Serum was carefully aspirated and transferred into dry clean Wasser –man tubes by using a Pasteur pipette and kept frozen at (-20c) till analysis, organs (liver, kidney, heart and spleen) were separated to calculate organs to body weight % at the end of the experiment period.

Human study:

Subject: the present study was conducted among 50 diabetic out patients attending Six October Hospital,

Dokky, Cairo, Egypt. The sample was randomly selected and divided into two groups as the follows:

Group 1: type I diabetic patients (n = 22(men 9&women 13)) Insulin Dependent Diabetes Mellitus (IDDM).

Group 2: type II diabetic patients (n= 28(men 12&women 16)) Noninsulin Dependent Diabetes Mellitus (NIDDM). Ages for patients arranged between (40 to 65) years old.

Study Design:

In the present study patients was assessed by measured height, weight,age, body mass index, as well as blood analysis of glucose by One Touch USA.

For all patients, Blood glucose were estimated as fasting and after 2hour from eating 50g carbohydrates of different types of bread, and also blood glucose were estimated as fasting and after 2 hour from eating 50 g of glucose to calculate glycemic index.

Glycemic Index:

The following review will provide an overview of the concepts of GI and GL, describe their limitations and discuss their applications for dietary planning and disease prevention.

* Common/popular definitions of GI:

- the rate of digestion and absorption of a carbohydrate-rich food
- blood glucose raising capacity of a carbohydrate-rich food

The operational definition of GI demonstrates the physiological complexity of the measure and illustrates why it is so infrequently used, particularly in the popular press.

* Operational (accurate) definition of GI: incremental area under the blood glucose curve (AUC) after the ingestion of 50 grams of a test food, expressed as a percentage of the AUC of an equal amount of a reference food (generally glucose or white bread) ***Jenkins et al.,(1981)***.

$$GI = \frac{\text{Blood glucose response to 50 g test food (e.g., beans)}}{\text{Blood glucose response to 50 g reference food (e.g. glucose)}} \times 100$$

As the definition indicates, the GI of a given food (i.e., the "test" food) is calculated by comparing the glycemic response to a 50 gram portion of the food with that of an equal portion of a reference food and multiplying that ratio by100. The calculated GI values are then categorized as low, medium and high; the numerical value that is representative of these categories depends on the reference food used (i.e., white bread or glucose).

Anthropometric measurements:

The anthropometric measurements used in this study included weights and heights from which body mass index (BMI) was calculated. National Heart Lung and Blood Institute (2012).

Glycemic Index Categories

Category	Glucose Reference*	White Bread Reference*
Low	< 55	< 60
Medium	55-70	60-85
High	> 70	> 85

* The reference food is arbitrarily assigned a GI of 100. Both glucose and white bread have been used as reference foods. Glucose has a glycemic response that is 40% greater than that of white bread; conversely, white bread has a GI that is 71% of glucose. (Jenkins et al., 1981).

Body Mass Index (BMI):

Body mass index (BMI) as an indicator of obesity, was calculated according to the following formula. National Heart Lung and Blood Institute (2012):

$BMI = \text{weight (kg)} / \text{height (m}^2\text{)}$

The grades of obesity utilizing the BMI.

Desirable range BMI $(20 < 25)$kg / m²
Grade I obesity BMI $(25 < 30)$ kg / m²
Grade II obesity BMI $(30 < 40)$ kg / m²
Grade III obesity BMI ≥ 40 kg / m²

The analytical methods of blood serum

1-Determination of serum glucose:

Serum glucose was determined according to Burrin and price (1985).

2-Determination of total cholesterol

Serum cholesterol was determined according to the enzymatic method described by Allain et al.,(1974).

3-Determination of triglycerides

The triglycerides in serum were colorimetrically determined according to Wahlefeld, (1974).

4-Determination of high density lipoprotein (HDL) cholesterol:

The HDL-c was determined according to Albers et al.,(1983).

5-Determination of very low density lipoprotein (VLDL) cholesterol

The concentration of VLDL-c was estimated according to the Fridewald's equation Fridewald et al., (1972).

VLDL-c = triglycerides / 5

6-Determination of low density lipoprotein (LDL) cholesterol:

According to Fridewald et al. (1972), low density lipoprotein cholesterol can be calculated as follows:

LDL-c = Total cholesterol – (HDL-c) -(VLDL-c).

Statistical Analysis:

Results were expressed as the mean ± SD. Data were statistically analyzed for variance using one-way analysis of variance (ANOVA) Granfeldt et al.,(1995).

Results and Discussions:

As shown in table (1), it could be observed that significant ($p \leq 0.05$) decrease in food intake and body weight gain ratio were showed in diabetic rats fed on basal diet (control positive) compared with healthy rats fed on basal diet (control negative). In addition, significant ($p \leq 0.05$) increase in food intake were showed in diabetic groups (5, 8&9) fed on diet containing type 3(whole corn flour), type 6 (whole corn +white riceflour 1:1) & type7 (whole wheat +whole corn +white rice1:1:1) of bread respectively, while other types of bread had no significant ($p \leq 0.05$) difference in food intake compared with control positive. Moreover, significant ($p \leq 0.05$) increase in body weight gain ratio were found in all diabetic groups fed on diets containing different types of bread comparing with diabetic rats fed on basal diet (control positive). The results may be due to the effect of fiber in cereals and legumes which reduced the risk for chronic diseases, this explanation is in line with the study by ***Kushi et al. (1999)***. Some of these include micronutrients such as selenium and vitamin E, antioxidants, phytochemicals, isoflavins and lignans. Since many of these factors occur together in cereals it is difficult to determine the precise benefits of each. While the benefits of the 'whole' grains have been demonstrated to reduce risk of CHD in women in the Nurses Health Study (***Liu et al., 1999)***.

Table (1): Effect of Egyptian bread prepared by different types of flour on food intake (FI) and body weight gain ratio (BWG%) of diabetic rats

Groups	FI (g/ day)	BWG %
Group (1): Control -	A	A
	17.20± 0.83	20.60± 0.89
Group (2): Control +	Cd	E
	11.80± 1.09	11.40± 1.34
Group (3): Bread 1	d	Bcd
	11.40 ± 1.34	15.40± 0.54
Group (4): Bread 2	D	Cd
	10.80± 1.09	14.0 ± 1.41
Group (5): Bread 3	A	Bc
	16.40± 1.67	16.40± 1.67
Group (6): Bread 4	Bc	Bcd
	13.60± 1.67	16.00± 2.91
Group (7): Bread 5	Bcd	Bcd
	12.20± 0.83	15.80± 2.49
Group (8): Bread 6	B	Cd
	13.80± 1.78	14.00± 1.41
Group (9): Bread 7	A	B
	16.60± 0.89	17.60± 1.67

Values with the same letters indicate no significant different ($p \leq 0.05$) and vice versa

Table (2): Effect of Egyptian bread prepared by different types of flour on organs to body weight gain ratio of diabetic rats

Groups	Liver / B.W. %	Kidney / B.W. %	Heart / B.W. %	Spleen / B.W. %
Group (1): Control -	C	D	D	D
	3.35±0.20	0. 606±0.01	0.350± 0.01	0.396±0.04
Group (2): Control +	A	A	A	A
	4.82±0.35	0.768±0.02	0.464± 0.04	0.510±0.04
Group (3): Bread 1	B	Bc	Bc	Bc
	4.16±0.46	0.656±0.01	0.414±0.02	0.434±0.02
Group (4): Bread 2	B	D	Bc	Cd
	4.10±0.45	0.606±0.01	0.408±0.02	0.426±0.01
Group (5): Bread 3	B	A	C	bc
	4.08±0.16	0.736±0.04	0.406±0.01	0. 438±0.01
Group (6): Bread 4	Bc	Cd	C	cd
	3.82±0.47	0.636±0.01	0.390±0.02	0.414±0.01
Group (7): Bread 5	Bc	B	C	bc
	3.85±0. 47	0.692±0.02	0.400±0.01	0.434±0.02
Group (8): Bread 6	B	Cd	Ab	b
	4.06±0.47	0.636±0.01	0. 448±0.02	0.464±0.02
Group (9): Bread 7	B	Cd	Bc	bc
	4.03±0.64	0.620±0.02	0. 422±0.03	0.442±0.01

Values with the same letters indicate no significant different ($p \leq 0.05$) and vice versa

Table (3): Effect of Egyptian bread prepared by different types of flour on serum glucose, total lipids, total cholesterol, low density lipoprotein, high density lipoprotein, very low density lipoprotein of diabetic rats

Groups	Glucose mg/dl	Total lipids g/l	T.Ch mg/dl	T.G mg/dl	LDL-c mg/dl	HDL-c mg/dl	VLDL-c mg/dl
Group (1): Control -	E	Cd	E	F	E	ab	f
	97.00± 4.58	2.67± 0.33	96.73± 0.83	147.18± 1.58	20.19± 0.46	47.10± 1.14	29.43± 0.31
Group (2): Control +	A	A	A	A	A	e	a
	189.60± 4.93	4.25± 0.52	168.26± 10.96	216.00± 11.40	87.63± 12.26	37.43± 3.53	43.20± 2.28
Group (3): Bread 1	D	Bc	Bc	C	Bc	de	c
	123.00± 7.58	2.91± 0.01	139.40± 13.66	188.30± 2.38	61.56± 13.46	40.20± 0.83	37.64± 0.49
Group (4): Bread 2	F	B	E	D	E	d	d
	89.80± 0.83	2.78± 0.18	104.13± 5.36	172.20± 4.38	28.89± 6.78	40.80± 2.49	34.44± 0.87
Group (5): Bread 3	E	Bc	Cd	D	Cd	cd	d
	100.80± 2.38	2.98± 0.04	133.00± 17.40	176.80± 4.02	54.81± 14.53	42.82± 3.00	35.36± 0.80
Group (6): Bread 4	C	B	B	Bc	B	cd	bc
	134.20± 6.57	3.35± 0.42	149.40± 5.36	192.00± 2.73	69.10± 5.68	41.90± 2.35	38.40± 0.54
Group (7): Bread 5	E	Cd	e	D	E	a	d
	96.00± 3.16	2.75± 0.19	108.12± 7.54	173.95± 3.55	25.51± 8.69	47.85± 1.95	34.76± 0.69
Group (8): Bread 6	Bc	Bc	D	Bc	D	cd	bc
	139.00± 1.73	3.02± 0.13	127.00± 7.58	189.40± 2.51	47.08± 7.97	42.04± 2.74	37.88± 0.50
Group (9): Bread 7	F	D	E	E	E	bc	e
	89.00± 1.87	2.33± 0.38	102.0± 2.73	161.00± 5.47	25.60± 2.60	44.20± 2.388	32.20± 1.09

Values with the same letters indicate no significant different ($p \leq 0.05$) and vice versa

T.Ch. Total cholesterol

T.G. Triglycerides

L.D.L-c Low density lipoprotein cholesterol.

H.D.L-c High density lipoprotein cholesterol.

V.L.D.L-c very low density lipoprotein cholesterol.

Table (4): Anthropometric measurements of Diabetic patients (mean ± SD)

	sex	Number	Age	weight	height	BMI
Diabetic I	men	9	36.00 ± 22.34 b	86.67± 30.14 a	168.33 ± 7.64 a	25.57± 8.32 c
	Women	13	52.40± 13.61 a	72.80 ± 4.38 b	163.00 b± 5.66	27.52± 3.19 b
Diabetic II	men	12	55.88± 10.36 a	74.86 ±9.67 b	165.29± 5.50 a	27.46± 3.64 b
	women	16	57.5 ± 9.29 a	87.50± 23.98 a	161.00± 4.97 b	31.52± 6.95 a

Values with the same letters indicate no significant different ($p \leq 0.05$) and vice versa.

Table (5): Glycemic index of Egyptian bread prepared by different types of flour

Type of bread	Diabetic (I)		Glycemic Index	Diabetic (II)		Glycemic Index
	Number	Hours		Number	Hours	
Type (1)	22.00	2.00	71 ± 6.00 c	28.00	2.00	72 ± 7.00 b
Type (2)	22.00	2.00	63 ± 6.00 d	28.00	2.00	64 ± 7.00 c
Type (3)	22.00	2.00	68 ± 9.00 c	28.00	2.00	75 ± 5.00 a
Type (4)	22.00	2.00	68 ± 2.00 c	28.00	2.00	65 ± 9.00 c
Type (5)	22.00	2.00	69 ± 3.00 c	28.00	2.00	63 ± 6.00 cd
Type (6)	22.00	2.00	79 ± 2.00 a	28.00	2.00	76 ± 7.00 a
Type (7)	22.00	2.00	76 ± 6.00 b	28.00	2.00	61 ±7.00 d
Glycemic index of Glucose = 100						

Values with the same letters indicate no significant different ($p \leq 0.05$) and vice versa.

From the data in table (2), it could be observed that significant ($p \leq 0.05$) increase in organs (liver, kidney,heart and spleen) to body weight gain ratio were showed for diabetic rats fed on basal diet (control positive) compared with healthy rats fed on basal diet (control negative), this result agreement with ***Velasquez et al,(1995)*** who reported that the increasing in kidney weight due to the renal changes, markedly by enlargement of the kidney is characteristic features of diabetic nephropathy in human. In addition, significant ($p \leq 0.05$) decrease in organs (liver, kidney,heart and spleen) to body weight gain ratio were observed for all diabetic groups fed on diets containing different types of bread comparing with diabetic rats fed on basal diet (control positive). ***Akila and Matsumoto,(1978)*** found that consumption of 4% or 8% cellulose has no effect on liver weight as expressed on the basis of 100gm body weight in chicks.

From the data in table (3), it could be observed that significant ($p \leq 0.05$)increase in serum glucose and lipids profile (total lipids, total cholesterol, triglycerides, LDL-c and VLDL-c) and also significant ($p \leq 0.05$)decrease in HDL-c were showed for diabetic rats fed on basal diet (control positive) compared with healthy rats fed on basal diet (control negative). In addition, significant ($p \leq 0.05$) decrease in serum glucose. Dietary fiber may be delay gastric empting and slow glucose absorption ***Blackburn et al,(1984)***. and lipids profile (total lipids, total cholesterol, triglycerides, LDL-c and VLDL-c) and also significant ($p \leq 0.05$)increase in HDL-c were observed for all diabetic groups fed on diets containing different types of bread comparing with diabetic rats fed on basal diet (control positive). The hypothesis of ***Kritchesky and Story,(1993)*** attributed that, the hypocholesterolemic effect of dietary fiber to increment excretion of bile acids or to inhibition of absorption of cholesterol due to binding of bile acids.. The best results were found in group (9) which fed on diet containing type 7 of bread (whole wheat + whole corn + white rice flours 1:1:1), followed by group (4) which fed on diet containing type 2 of bread (whole wheat flour 100%). The results are agreement with ***Arturo, et al., (2004)*** which conclude that a low GI diet with more than 23g fiber per day may help to improve dyslipidemia in individuals with type 2 diabetes. And also there is an important body of evidence in support of a therapeutic potential of a low-GI carbohydrate diet taken during the 3 meals, but not only once at breakfast, in subjects with type 2 diabetes and dyslipidemia ***Brand et al. (1998), Wolever et al. (1992), Jarvi et al. (1999)and Frost et al. (1999).***

From the data in table (4), it could be observed that significant ($p \leq 0.05$) increase in age were showed for men diabetic II compared with men diabetic I, while non-significant ($p \leq 0.05$) increase in age were showed for women diabetic II compared with women diabetic I. In addition, significant ($p \leq 0.05$) increase in body mass index BMI were observed for men and women of diabetic II compared with men and women diabetic I respectively. The results were agreement with previous studies which concluded that the protective association in the extreme quintiles revealed a risk ratio of 0.64–0.72, after correcting for related variables such as age, BMI, smoking and physical activity. Two of the studies reported that glycaemic load is associated with risk of diabetes. They showed an increased relative the risk of type 2 diabetes of 2.2 in women and 2.1 in men, with a combination of low cereal fiber intake and a high glycaemic load ***Salmeron et al. (1999)and Salmeron et al. (1999).***

From the data in table (5), it could be observed that lowest values of glycaemic index were showed for type 2 of bread (whole wheat flour 100%)(63 ± 6.00) this result agreement with similar to another study which done by ***David et al., (2012***) showed that cereal fiber in the diet may be a marker for another component of whole grains that imparts health advantages or a healthy lifestyle. Another study showed that 30 gm of whole wheat having GI value equals to 65 and Glycemic load equals to 7.4 while GI of mixed grain bread is 34 and its GL is 4.3 ***Fiona et al., (2008)***. Followed by type 3 (whole corn 100%) (68 ± 9.00) and type 4 (whole wheat + whole corn 1:1) (68 ± 2.00) in diabetic I respectively. While, lowest values of glycaemic index were showed for type 7 of bread (whole wheat + whole corn + white rice flour 1:1:1)(61 ± 7.00) followed by type 5 (whole wheat + white rice flour 1:1)(63 ± 6.00) and type 2 (whole wheat flour 100%)(64 ± 7.00)in diabetic II respectively. Another study by ***Hu et al,. (2012)*** revealed that the higher consumption of white rice is associated with a significantly increased risk of type 2 diabetes, especially in Asian (Chinese and Japanese) populations. While ***Fiona et al., (2008)*** found that white rice has GI equals to 58 and rice flour is 95.

On the other hand, the highest values of glycaemic index were showed for type 6 of bread (whole corn + white rice flour 1:1) (79 ± 2.00) followed by type 7 of bread (whole wheat + whole corn + white rice flour 1:1:1) (76 ± 6.00) in diabetic I, while highest values of glycaemic index were showed for type 6 of bread (76 ± 7.00) followed by type 3 of bread (whole corn flour 100%)(75 ± 5.00) in diabetic II. This result in line with the study which revealed that the corn is a nutrient-rich food

classified as a starch on the Diabetes Food Pyramid, along with grains, potatoes, peas and beans. With a glycemic index (GI) of 42, corn is also classified as a low-GI food, meaning that corn raises blood sugar by a relatively small amount. The healthy effects of eating corn may be negated, however, by consuming the wrong type of corn products ***Emilia (2012).***

Conclusion:

The present study concluded that the blood glucose response to a food is not accurately predicted by the content of available carbohydrate in the food but also Glycaemic index (GI) is a useful index to describe the extent to which certain food can increase the blood glucose in human. It's suggested using types of breads had low-GI carbohydrates would be benefit to patients with type 2 diabetes.

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