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Impact of Wheat Bran Addition to Iraqi Bread on Postprandial Glycaemia

Abstract- *White wheat flour is used to make different types of bread, among them is "Samoon" a type very common by Iraqi people. White wheat flour is considered responsible for many health problems, and this work deals with studying the impact of adding bran to this bread on postprandial glycaemia to improve its quality. For this purpose volunteers of healthy people were fed different mixture of wheat white flour and bran (0 – 40 %), and the increase of glucose blood level was measured. The volunteers were fed a breakfast of 50 g of bread that contain different percentage of bran, after eight hour fasting. The glucose level in their serum was measured at different time intervals and plots of its variation as a function of time was obtained. The shape of these plots revealed many observations, among them is the decrease in the position of the glucose maxima on increasing the bran percentage. This decrease is associated with increase in the position of the maxima on time scale. After 120 minutes, the glucose level reaches almost normal levels, which is a little bite higher than the start point. Further observation is related to the glycemic load and palatability, which were thoroughly discussed in the text. The consequences of these observations is that the presence of bran, in a percentage close to that of natural one, is recommended for people health and should be recommended normal people and diabetic patients.*

Keywords- *Fiber; barley; β-glucan; glucose; insulin; polysaccharides*

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1. Introduction

Glycemic index (GI) is a measure of the blood glucose-raising potential of a carbohydrate relative to that of glucose (100 %). Nutritionist realized the importance of the Glycemic index (GI) to distinguish between distinctive sort of food in raising the blood glucose level as a function of time [1-3]. Many foods showed different pattern plot for glucose level as a function of time, and many GI values were reported in the literature [4-5]. A low-GI food will release glucose more slowly and steadily, which leads to more suitable postprandial (after meal) blood glucose readings [6-8]. A high-GI food causes a more rapid rise in blood glucose levels and is suitable for energy recovery after exercise or for a person experiencing hypoglycemia. Food with high glycemic index, in which the extreme cases were found in glucose itself, and other starch containing foods such as white flour, rice, potatoes etc., with values of GI in the range of 90 -100 %. On the other hand, low glycemic index foods such as lentils, peas, beans, pea nuts etc., showed lower values of GI in the range 15 - 35 %. It was amazing to know that whole bran wheat showed low value of G.I of ~ 40 % compared to white flour, although the carbohydrate content of both of them is not very different [9-12]. Numerous researchers concentrated on the effect of eating food with a low glycemic index contrasted with high glycemic load foods [9].

There is a need for another factor to get the full view of the extent of carbohydrate fate, viz. the Glycemic load (GL), which accounts for how much carbohydrate is in the food and how much each gram of carbohydrate in the food raises blood glucose levels. Glycemic load (GL) is based on the glycemic index (GI), and is calculated by multiplying the grams of carbohydrate available in the food times the

food's GI and then dividing by 100 [13-16]. The GI value has proven to be a more useful nutritional concept than is the chemical classification of carbohydrate, as simple or complex, as sugars or starches, or as available or unavailable. This is the case that pick the attention of many scientists, what bran contain to lower the GI value of wheat, the principle food of mankind, from 100 % to 40 % [17-20]. Many reports refer to contents of wheat bran of fiber mainly composed from a material known as β-glucan, a non-starch polysaccharide that is found in other grain such as oat, barley, mushrooms, and yeasts [19]. The levels of β-glucan are influenced by both genetic and environmental factors, although genetic factor appears to be of greater importance. Addition of β-glucan predictably reduces the glycemic index (GI) while maintaining palatability in a 50 g carbohydrate portion (enriched cereal). Each gram of β-glucan reduces the GI by 4 units, making it a useful functional food component for reducing postprandial glycaemia [21-23].

Iraqi people use many types of breads; among the mostly used is “Samoon”, which is made of 100 % wheat white flour. This bread can be classified as a high glycemic index food, and its carbohydrate content will effect on postprandial glycaemia, hence will elevate blood glucose and insulin levels, and stimulate fat-storage [6]. The aim of this work is to study the effect of adding a varying amount of wheat bran on the glycemic index of Iraqi bread “Samoon”.

2. Material and Methods

I. Materials

Wheat bran-white flour mixtures were prepared by mixing solid materials with the following weight of bran 0, 5, 10, 15, 20, 25, 30, 35, and 40 g and completing the weight with wheat white flour to 100 g.

II. Instruments

Glucose level in serum was recorded by using blood glucose meter type Glucocard 01, arkay, Japan, which is recommended by the Iraqi Ministry of Health, and calibrated with standard glucose solution of high purity glucose, 70 to 150 mg/100 mL.

III. Participants:

Healthy group of volunteers (10 male and 10 female within the age 15 - 19 year) were subjected to this experiment. They fed a breakfast of 50 g of Iraqi bread, locally called “Samoon” prepared from the above mentioned mixtures of wheat bran-flour.

IV. Method:

The glucose level in serum was measured at different time intervals; 0, 15, 30, 45, 60, 75, 90, 105, 120, and 135 minutes after 8 hours fasting. The percentage of bran was increased daily, and the participants didn`t exercise any physical activities during the measurements. The glucose level in serum was plotted against time (120 minute) and the results were presented in Figure-1, and area under the curve % was obtained by Excel software. Glycemic load was calculated from the reported amount of carbohydrates in white flour and bran, Table 1.

V. The palatability test

The palatability were estimated by giving the mentioned wheat bran:flour mixtures to the volunteers and asking them to arrange their estimated value on taste, texture, color, flavor, response of their digestion system within 24 hour.

3. Results and Discussion

Samoon is the principle food for Iraqi people, which is made from wheat white flour only. There is no intention by the public to mix it with any constituent containing fibers. Accordingly, there is a great need to investigate the impact of adding wheat bran to this type of bread concerning the dietary value and palatability. To study the effect of adding bran as a source of fibers, healthy volunteers of very close ages were fed a serving of 50 g mixture of wheat white flour and bran. Their glucose level in serum after 8 hour of fasting were measured on interval of 15 minute for 120 minutes, the serving contain varying weight percentage (0-40 %) of white wheat bran. The glycemic index of a food is defined as the incremental area under the two-hour blood glucose response curve (AUC) following a 8-hour fast and ingestion of a food with a certain quantity of available carbohydrate (usually 50 g). The AUC of the test food is divided by the AUC of the standard (glucose) and multiplied by 100. The average GI value is calculated from data collected in 10 human subjects. Both the standard and test food must contain an equal amount of available carbohydrate. Serum glucose level was determined at 0, 15, 30, 45, 60, 75, 90, 105, and 120; every day was allocated for one mixture. The results of this experiment were presented in Table 1, in which the maximum glucose level was recorded, along with time needed to reach these maxima.

Table 1: The change in glycemic index, the H_{Max} %, glycemic load (calculated) with the bran percentage.

Bran %	Carbohydrate content (%)			Values obtained from the plot			G.L (calculated)	Palatability (1 - 10)
	WF*	WB**	Total	G.I	H_{Max} %	Time of (H_{max})		
0	35.0*	0.00	35.00	100.00	100	20	35.0	5.0
5	33.25	0.60	33.95	82.41	95	22	28.0	5.0
10	31.5	1.20	32.70	71.61	93	24	23.4	6.0
15	29.75	1.80	31.55	69.51	90	30	21.9	5.5
20	28.00	2.40	30.40	58.32	87	32	17.7	6.4
25	26.25	3.00	29.25	56.82	83.6	34	16.6	6.0
30	24.50	3.60	28.10	55.98	80.3	36	15.7	6.6
35	22.75	4.20	26.95	53.57	77	39	14.4	7.0
40	21.00	4.80	25.80	52.97	74	42	13.7	7.9

WF* = Wheat flour; WB = Wheat bran; G.I.= glycemic index.**

The area under the curve (AUC) was determined by using excel program. Much useful information can be drawn from this figure. Before adding the bran, glucose blood level in serum for each volunteer, was in the range of 83 - 87 mg/100 mL, reaching the highest value of 140 mg/mL within ~ 20 minutes. On increasing bran percentage, the maximum level of blood glucose start to decrease, while the needed time for reaching this maxima increased to highest value of 40 minute. It is very important to note that the area under the curve for these plots are not constant, in general it decrease on increasing the bran percentage from 100 to 52.97 %. On increasing the bran percentage, a nondirectional change in glucose level was observed, expressed as a slight decrease in its maxima; i. e reduction in the GI; as well as the increase of the time needed to reach maximum level (from 20 to 42 minutes). After 120 minutes the glucose level was reduced to the normal, or a little bite higher than normal level of ~ 86 mg/100 mL. The value of the GL for each serving was calculated from the equation:

GL_{Food} = [GI_{Food} × (amount of available carbohydrate)$_{Food}$ (g) per serving]/100

Figure 2, represent a plot of the reflected change in the glycemic index (GI), the maximum hight H_{Max} %, and the calculated glycemic load (GL) resulted from the replacement of some of the white flour with bran. Generally, the two variables viz. GI, and GL showed an inverse proportionality with increasing the bran percentage in the bread. When GI plotted as a function of the bran percentage, the resulted plot reveal the absence of direct relationship between them. In other word the increase in the bran percentage in the servings will reduce its GI value, as shown in Figure 2. Many literatures explained this behavior to be due to the increase in the amount of the included ß-glucan in wheat bran [21-23]. Almost all low glycemic index foods are good sources of fiber, and therefore, as the glycemic index of the diet was reduced, the amount of fiber was increased.

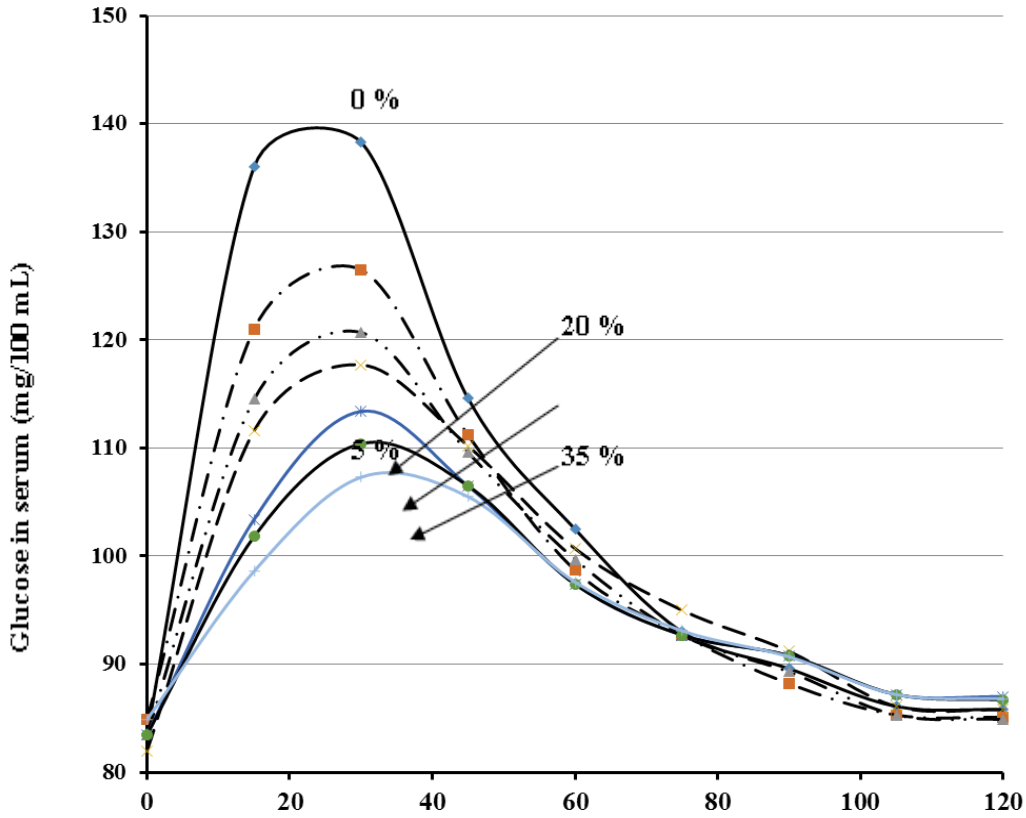

Figure 1: The change in blood serum level with time after increasing the percentage of bran in the Iraqi bread Samoon

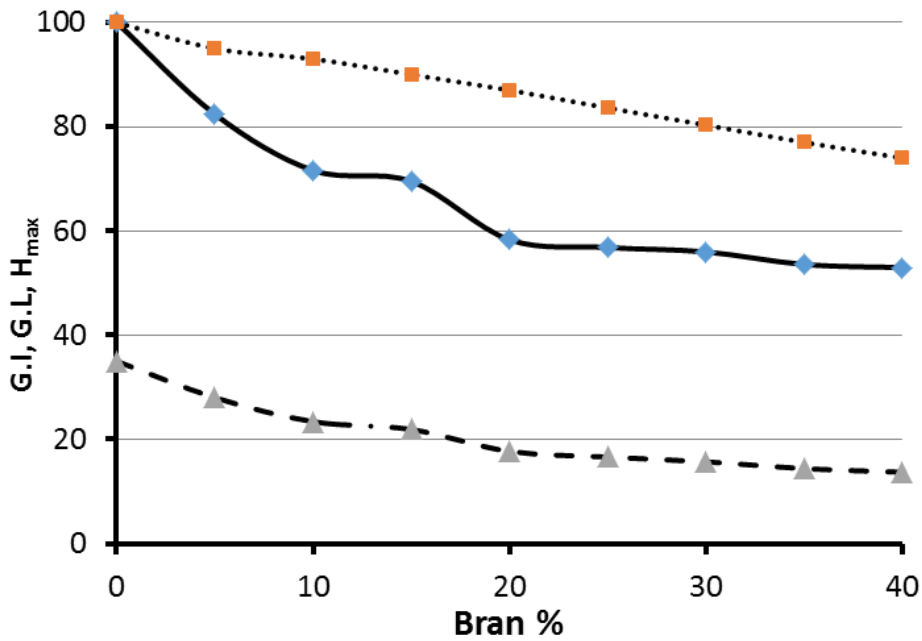

Figure 2: The change in H_{Max} % (——), area under the curve % (– –), and glycemic load (calculated) (…) with the bran percentage

A reduced glycemic load can be achieved by simply reducing the amount of carbohydrate-containing foods that are consumed, and/or by including low glycemic index foods and increasing fiber. It was determined that a reduction in fasting blood glucose was better achieved by including more low glycemic index foods (like beans), rather than decreasing glycemic load by reducing carbohydrate intake Bran quality and quantity greatly influence the

level of blood glucose, and its nutritional value due to the presence of high constituent of dietary fiber, as well as beta-glucan, essential fatty acids, minerals, vitamins and proteins. Accordingly increasing the bran content in a given meal bread means glycemic index depression. Which lead to decrease the blood sugar level, without the need to stimulate the pancreas to secret insulin? Thus, weight of fiber can actually be subtracted from total weight of the serving; hence fiber can be good for people with diabetes. Some literature estimated the average of dietary fiber needed per person to be 20-35 gm daily [29]. One of sugars major drawbacks is that it raises the insulin level, which inhibits the release of growth hormones, and consequently promotes the storage of fat, which lead to weight gain and elevated triglyceride levels [30]. The main sources of external factor on blood sugar are diet, exercises, stress and sleep [31].

4. Conclusions

From the results of this study, it is apparent that adding wheat bran to the wheat white flour in Samoon baking has significant effect on its dietary value. A reduced glycemic load can be achieved by simply including low glycemic index foods or increasing fibers, as well as reducing the amount of carbohydrate-containing foods that are consumed. So, it is recommended to add wheat bran to all type of bread consumed by the Iraqi people to avoid stimulating insulin secretion, and hence their bad consequences on individual health.

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