



## Original Article

## Exploring The Effect Of Mutigrain Flour On Glycemic Index Of Diabetic Rats Model

Sehrish Rafique<sup>1</sup>, Shaista Jabeen<sup>1</sup>, Tabussam Tufail<sup>\*</sup>, Huma Bader Ul Ain<sup>1</sup>, Rizwan Shoukat<sup>1</sup>, Zarina Yasmin<sup>2</sup><sup>1</sup> University Institute of Diet and Nutritional Sciences, Faculty of Allied Health Sciences, The University of Lahore, Lahore, Pakistan<sup>2</sup> Post-Harvest Research Centre, Ayub Agricultural Research Institute, Faisalabad, Pakistan.

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## \*Corresponding Author:

Tabussam Tufail

University Institute of Diet and Nutritional Sciences, Faculty of Allied Health Sciences, The University of Lahore, Lahore, Pakistan

[tabussam.tufail@dnsc.uol.edu.pk](mailto:tabussam.tufail@dnsc.uol.edu.pk)Received Date: 1<sup>st</sup> July, 2022Acceptance Date: 10<sup>th</sup> July, 2022Published Date: 31<sup>st</sup> July, 2022

## ABSTRACT

The glycemic index is a measure that assesses the quantity of carbohydrates in meals on a range of zero to 100, reflecting how rapidly an item raises blood sugar. Multigrain flour stayed active for eating, and it had greater storage stability. **Objective:** To evaluate the effect of multigrain flour on glycemic index and insulin levels of diabetic rats. **Methods:** The Current study was designed to evaluate the effect of multigrain flour on diabetes. Sample size was 60 male rats (3 groups were made) 20 in each group and Convenient sampling was used. Proximate chemical analysis of the multigrain flour was also done. SPSS version 24.0 was used to tabulate and analyse the data. **Results:** Highest feed intake at week 1 was (24.10 ± 0.48 g/rat) and highest feed intake at week 4 was (25.80 ± 0.95 g/rat). Highest water intake at week 1 was (21.03 ± 0.51 mL/rat) and highest water intake at week 4 was (25.52 ± 0.54 mL/rat). Highest blood glucose level at 0-day was (177.27 ± 2.40 mg/dL) and highest blood glucose level at 30<sup>th</sup> day was (149.57 ± 4.51 mg/dL). Highest glycemic index value at week 1 (0-minute) was (136 ± 2.04), highest glycemic index value at week 1 (30-minute) was (165 ± 2.47), highest glycemic index value at week 1 (60-minute) was (165 ± 2.47). **Conclusions:** This approach is also beneficial in the management of a variety of disorders. The addition of micronutrients to multi grain flour can boost the nutritional content of goods while also extending their shelf life.

## INTRODUCTION

Poaceae and Gramineae include seeds and grains from cereals. Triticale, oats, rye, maize, and other grains are accessible in various places. Wheat produces nearly half of the world's cereal production, according to global standards. Various structural similarities are identified across all cereals connected with a foetus with chromosomes for a completely new species, as well as a reproductive apparatus clogged with starch grains [1-3]. Diabetes mellitus is a group of metabolic disorders marked by hyperglycemia as a result of insulin shortage, insulin dysfunction, or both. Diabetes causes long-term damage, malfunction, and acute abnormalities in a variety of organs, including the eyes, kidneys, nerves, heart, and blood vessels [4]. Humans have been eating cereals for a long time. These problems are sensitive to diabetes

complications that have been present for a long time, such as insulin-dependent diabetes mellitus (IDDM) and non-insulin-dependent diabetic mellitus (NIDDM), both of which cause significant morbidity [5]. Millets and grains can supply additional minerals, phytochemicals, and antioxidants, all of which are essential for overall health [6]. Utilization of remedial multigrain multigrain flour in food products is an area of current interest because of consumer and changing demographics [7]. Foods with a low glycemic index are linked to better metabolic and vascular disease prevention and treatment [8]. Later research revealed that a variety of parameters linked to food consumption affect the rate of glucose absorption, as well as glycemia and insulinemia. At this point, it was thought that rigorous documenting of the distinctions

between carbohydrate meals was necessary. The glycemic index categorization of foods that resulted gave a numerical physiologic classification of significant carbohydrate items in the prevention and treatment of disorders like diabetes [9]. Many dieticians and endocrinologists have indicated that illnesses are connected to defective feeding patterns caused by a lack of variety and increased intake of wheat and rice-based refined meals, based on observations and scientific evidence. Further research has discovered that high-GI meals cause greater eating problems in obese persons than in people of normal weight. Dieticians recommend millets to fight these side effects because of their high fibre content and vitamin profile, which promote a balanced diet. Multigrain flour, for example, is one of several commercial goods with a high nutritional fibre and protein content that has recently entered the Indian market [10,11].

## METHODS

The Current study was designed to evaluate the effect of multigrain flour on diabetes. Convenient sampling was used. This study was conducted at Allied Health Sciences, Lab no.102, University Institute of Diet and Nutritional Sciences (UIDNS), The University of Lahore. Study Duration was 9 months after the approval of synopsis. Sample size was 60 male rats (3 groups were made) 20 in each group were housed in animal room of IMBB, The University of Lahore. Inclusion Criteria was that male Rats having weight of 200-250 g were used as biological model in the study. Exclusion Criteria was that under weight male and female rats were excluded. Rats that were engaged in other experiments were also excluded from the study. Proximate chemical analysis of the multigrain flour was also done. SPSS version 24.0 was used to tabulate and analyse the data [12, 13].

## RESULTS

The inherent composition of food, as well as the proportions of nutrients, determine its quality. The analysis of food components has a considerable impact on the final nutritional content as well as customer approval. The moisture, crude fibre, crude protein, crude fat, and percentage composition of a food sample were determined through compositional analysis. The following table 1 and 2 shows the bioactive composition and proximate composition of multigrain flour. Bioactive compounds in multigrain flour were analyzed by spectrophotometric method and following detections were observed. Anti-oxidant activity (DPPH) was  $22.64 \pm 0.3$  ( $\mu\text{mol TE/g}$ ), Total phenolic contents (TPC) was  $1500 \pm 0.5$  (mg GAE/100g) and Total flavonoids contents (TFC) was  $500 \pm 0.7$  ( $\mu\text{g RE g}^{-1}$ ). Table 3 and 4 indicates the mean values for the glycemic

index of rats in different treatments at different days. Figure 1A indicates the graphical representation of the mean values of the feed intake in different treatments. X-axis indicates the treatments and weeks as the independent variable and y-axis shows the feed intake of rats in grams as the dependent variable. The primary reason for these results is that, T1 values are higher because in this treatment healthy rats were fed with multigrain compared to T0 and T2, where multigrain was not fed in T0 and in T2 diabetic rats were used. Diabetic rates recovered with the passage of time but the increase in feed intake was lower than other two groups of healthy rat. Figure 1B indicates the graphical representation of the mean values of the water intake in different treatments. X-axis indicates the treatments and weeks as the independent variable and y-axis shows the water intake of rats in milliliter as the dependent variable. Figure 1C indicates the graphical representation of the mean values of the blood glucose level in different treatments. X-axis indicates the treatments and days as the independent variable and y-axis shows the blood glucose level of rats in mg/dL as the dependent variable. Blood sugar level in T2 is highest because in this group, diabetic rats were used. Furthermore, with the passage of time blood sugar level decreased by eating the multigrain. Figure 1D indicates the graphical representation of the mean values of the insulin level in different treatments. X-axis indicates the treatments and days as the independent variable and y-axis shows the insulin level of rats in  $\mu\text{IU/mL}$  as the dependent variable. Insulin level in T2 is highest because in this group, diabetic rats were used and more insulin produced in response to high sugar. Furthermore, with the passage of time insulin level decreased in diabetic rats by eating the multigrain.

Bioactive compound analysis of multigrain flour	
Anti-oxidant activity (DPPH)	$22.64 \pm 0.3$ ( $\mu\text{mol TE/g}$ )
Total phenolic contents (TPC)	$1500 \pm 0.5$ (mg GAE/100g)
Total flavonoids contents (TFC)	$500 \pm 0.7$ ( $\mu\text{g RE g}^{-1}$ )

**Table 1:** Bioactive compounds

	Multigrain flour	Wheat	Oats	Quinoa	Rice	Maize
Moisture contents	$21.34 \pm 0.05$ (%)	$23.23 \pm 0.05$ (%)	$19.98 \pm 0.05$ (%)	$20.34 \pm 0.05$ (%)	$20.34 \pm 0.05$ (%)	$21.34 \pm 0.05$ (%)
Protein contents	$17.87 \pm 0.02$ (%)	$16.77 \pm 0.02$ (%)	$17.23 \pm 0.02$ (%)	$18.17 \pm 0.02$ (%)	$15.23 \pm 0.02$ (%)	$19.33 \pm 0.02$ (%)
Fat contents	$12.12 \pm 0.01$ (%)	$10.12 \pm 0.01$ (%)	$10.44 \pm 0.01$ (%)	$13.15 \pm 0.01$ (%)	$10.22 \pm 0.01$ (%)	$11.42 \pm 0.01$ (%)
Ash contents	$4.83 \pm 0.005$ (%)	$5.38 \pm 0.005$ (%)	$4.48 \pm 0.005$ (%)	$4.73 \pm 0.005$ (%)	$5.15 \pm 0.005$ (%)	$4.11 \pm 0.005$ (%)
Fiber contents	$2.18 \pm 0.1$ (%)	$3.12 \pm 0.1$ (%)	$2.78 \pm 0.1$ (%)	$2.00 \pm 0.1$ (%)	$2.12 \pm 0.1$ (%)	$1.75 \pm 0.1$ (%)
NFE (%)	$41.66 \pm 0.21$ (%)	$38.52 \pm 0.21$ (%)	$39.42 \pm 0.21$ (%)	$41.13 \pm 0.21$ (%)	$40.86 \pm 0.21$ (%)	$42.22 \pm 0.21$ (%)

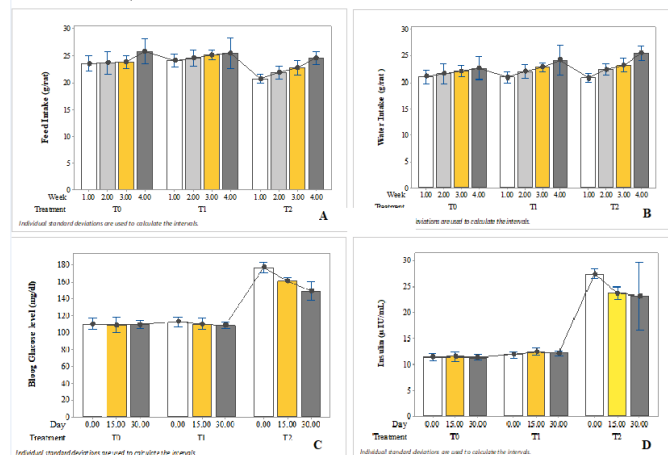
**Table 2:** Proximate chemical analysis of the multigrain flour

Treatments	Week 1 (0-min)	Week 2 (0-min)	Week 3 (0-min)	Week 4 (0-min)
T <sub>0</sub>	92±2.21 <sup>fg</sup>	91±3.19 <sup>efg</sup>	89±1.69 <sup>de</sup>	88±0.58 <sup>cd</sup>
T <sub>1</sub>	87±1.74 <sup>g</sup>	89±2.14 <sup>def</sup>	86±1.29 <sup>cd</sup>	83±2.91 <sup>b</sup>
T <sub>2</sub>	136±2.04 <sup>g</sup>	125±2.63 <sup>cdde</sup>	115±2.57 <sup>bc</sup>	111±4.41 <sup>a</sup>

**Table 3:** Glycemic index table at different weeks and 0-minutes

Treatments	Week 1 (0-min)	Week 2 (0-min)	Week 3 (0-min)	Week 4 (0-min)
T <sub>0</sub>	144±3.46 <sup>fg</sup>	145±5.07 <sup>defg</sup>	150±2.85 <sup>de</sup>	144±3.18 <sup>cd</sup>
T <sub>1</sub>	142±2.84 <sup>g</sup>	139±3.34 <sup>def</sup>	135±2.03 <sup>cd</sup>	130±2.95 <sup>b</sup>
T <sub>2</sub>	200±3.00 <sup>g</sup>	189±3.99 <sup>cdde</sup>	177±3.91 <sup>bc</sup>	172±4.18 <sup>a</sup>

**Table 4:** Glycemic index table at different weeks and 60-minutes



**Figure 1:** A) Means of feed intake by rats on weekly basis. B) Means of water intake by rats on weekly basis (mL/rat). C) Means of blood glucose levels in rats. D) Means of insulin levels in rats

## DISCUSSION

Finally, the physical, chemical, and sensory evaluations of multigrain flour as well as the storage stability of the fortificant produced good findings. Multigrain flour stayed active for eating, and it had greater storage stability [14]. The finest quality multigrain flour may be manufactured along with wheat flour, according to the findings of this study. This will be both nutritional and beneficial to your health. The current study's findings might be crucial in determining whether or not to fortify straight grade wheat flour with multigrain flour to improve nutrition. The findings of this study may prove to be extremely useful in the development of new, highly nutritious food items. The results of feed and water intake in the study are in similar with the findings of Qi et al., who studied the relationship of diet to wit diabetes to cure the patients [15]. The findings of the study also matched with the results of the Tufail et al., who studied the effect of diet on glycemic index of women [16]. The results of blood glucose level in the study are in similar with the findings of Meynier et al., who studied the glycemic index values [17]. The findings of the study also matched with the results of the Brennan who studied the effect of multigrain bread on glycemic index of females

suffering with type 2 diabetes [18]. The results of insulin level in blood in the study are in similar with the findings of Indrani et al., who studied the glycemic index values [19]. The findings of the study also matched with the results of Liu et al., who studied the effect of oat type 2 diabetes in patients [20].

## CONCLUSION

Foods that give special health advantages in addition to basic nutrients are referred to as functional foods. They are consumed as a staple meal by around 90% of Pakistan's population. Wheat, like other grains, is lacking in micronutrients such as zinc, vitamin A, and iron, which can contribute to a variety of significant disorders. Malnutrition is a severe issue in developing and underdeveloped nations, including Pakistan. Micronutrient fortification is becoming a prevalent method in the baking business to enhance people's health. This approach is also beneficial in the management of a variety of disorders. The addition of micronutrients to multi grain flour can boost the nutritional content of goods while also extending their shelf life. As a result, the current technique was used to test the stability of multigrain flour.

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