RESEARCH PAPER — FOOD SCIENCE RESEARCH JOURNAL

e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 7 | Issue 2 | October, 2016 | 170-175
DOI : 10.15740/HAS/FSRJ/7.2/170-175

Effect of supplementation of wheat grass (*Triticum aestivum* L.) powder on blood glucose level of selected diabetic subjects

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Diabetes mellitus is reaching potentially epidemic proportions in India. The experiment was conducted with an objective to study the effect of supplementation of wheat grass powder on blood glucose level of the diabetic subjects. Thirty non-insulin dependent diabetic subjects as control group (15) and experimental group (15) were selected from Parbhani city of Maharashtra state. Data regarding anthropometric measurements and fasting as well as post prandial blood glucose level of the selected subjects of control and experimental group was recorded initially, at 30th day and 60th day of experiment. Supplementation of 3 g of wheat grass powder was given daily to the subjects of experimental group for 60 days. The anthropometric measurements such as weight (kg), body mass index, mid upper arm circumference (cm) and triceps skinfold thickness (mm) were found to be decreased after the supplementation of wheat grass powder for two months, but the significant difference was noticed only for weight and BMI values. On the other hand specific trend was not noticed in the anthropometric measurements of the subjects of control group. Mean fasting and post prandial blood glucose level of the selected diabetic subjects of experimental group were significantly decreased from 192.13 ± 59.41 mg/dl to 179.46 ± 54.79 mg/dl and from 266.93 ± 81.47 mg/dl to 244.86 ± 77.59 mg/dl, respectively after 60 days of supplementation of wheat grass powder, whereas slight increase was noticed in the selected diabetic subjects of control group. Hence, supplementation of wheat grass powder for two months resulted in reducing the blood glucose level of diabetic subjects therefore being a natural product; wheat grass could be considered as effective measure for management of diabetes mellitus.

Key Words : Wheat grass (*Triticum aestivum* L.) powder, Diabetes mellitus, Anthropometric measurements, Fasting blood glucose level, Post prandial blood glucose level

How to cite this article : Choudhary, Mayuri M. and Nalwade, Vijaya M. (2016). Effect of supplementation of wheat grass (*Triticum aestivum* L.) powder on blood glucose level of selected diabetic subjects. *Food Sci. Res. J.,* **7**(2): 170-175, **DOI : 10.15740/HAS/FSRJ/7.2/170-175**.

INTRODUCTION

Diabetes mellitus is a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both (WHO, 2014). Diabetes mellitus is reaching potentially epidemic proportions in India. The prevalence of diabetes increased tenfold, from 1.2 per cent to 12.1 per cent, between 1971 and 2000. It is estimated in 2011 that 61.3 million people aged 20-79 years live with diabetes in India. This number is expected to increase to 101.2

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million by 2030 (*http://www.idf.org/diabetesatlas*). In India the disease is now highly visible across all sections of the society due to steady migration of people from rural to urban areas, economic boom and corresponding change in life style.

Dietary supplements as well as oral hypoglycaemic compounds from various medicinal plants provide a useful source for the development of new pharmaceutical adds to existing therapies for diabetes (Bailey and Day, 1989). In this regard cereal grasses of young green plant is an upcoming "functional foods" because of its nutritional and health benefits (Saikia and Deka, 2011).

Wheat grass has been traditionally used, since ancient times, to treat various diseases and disorders. Shoot of *Triticum aestivum* L. is called as a wheat grass, belonging to family: Gramineae (Chawla *et al.*, 2015). Wheat grass has been proved to contain essential amino acids, proteins, vitamins, minerals, active enzymes, bio flavanoids and chlorophyll which are beneficial for health. Beside these, wheat grass possess antibacterial, antioxidant, anticancer and antiulcer property. Blood purification, liver detoxification and colon cleansing are the three important effects of wheat grass on human body. It chemically neutralizes environmental pollutants, enhances immunity, restore energy and vitality (Mogra and Rathi, 2013). Wheat grass seems to be very promising herbal drug hence, an attempt has been made to study the effect of supplementation of wheat grass powder on blood glucose level of the diabetic subjects.

METHODOLOGY

Thirty non-insulin dependent diabetic subjects of 40 to 70 years of age based on their past medical history and blood glucose level were selected randomly from Parbhani city of Maharashtra state. The study was approved by institutional ethics committee and an informed consent was taken from the subjects prior to recruitment in the study. The subjects were divided equally into two groups as control group (15) and experimental group (15). All the selected subjects were allowed to continue and follow their usual living style, diet, exercise and medicines during the study period. The information regarding socio-economic back ground was collected by personal interview method using pre-tested questionnaire.

The anthropometric measurements *viz*., weight (kg), height (cm), mid upper arm circumference (cm) and triceps skin fold thickness (mm) of the selected subjects of control and experimental group were recorded initially and after 30 and 60 days of experimental period following standard procedures given by Jelliffe (1966). The anthropometric data were further used for computing body mass index (BMI) by using the Quetlet's body mass index formula.

Wheat grass powder of "Lokvan" variety was procured from "Herbal Hills" located at Lonavala of Maharashtra state and stored in airtight plastic container till the end of the study period. Exact amount of 3 g of wheat grass powder was filled in the zip lock bags in hygenic condition and given to all subject of the experimental group. They were asked to dissolve daily one sachet of 3 g of wheat grass powder in one glass of water and to drink empty stomach everyday morning for a continuous period of 60 days. Fasting and post prandial blood glucose level (mg/dl) of the subjects in control and experimental group were recorded initially and after 30 and 60 days of experimental period. The finger prick blood sample was taken and analyzed using glucometer 'One Touch-Select Simple'. The subjects of control group were not given any supplementation. In order to draw valid conclusions from the present study the collected data were consolidated, computed and exposed for statistical analysis (Panse and Sukhatme, 1989).

OBSERVATIONS AND ASSESSMENT

The present investigation was undertaken to study the effect of wheat grass supplementation on the blood glucose level of the selected diabetic subjects.

Information regarding socio-economic status of the selected diabetic subjects was collected by personal interview method. Out of 30 selected diabetic subjects, 15 were male and 15 were female. Majority (80 %) of the subjects were belonging to 41 to 50 years (40 %) and 51 to 60 years (40 %) of age group and the remaining 20 per cent were from 61 to 70 years of age group. Maximum subjects were having education upto secondary school and belonged to the nuclear families. Most of the subjects were homemaker and were from high economic status. *i.e.* monthly family income Rs. > 25000 to $\leq$ 50000.

Anthropometric measurements of control group are presented in Table 1. Height of the subjects in control group were ranging from 145 – 179 cm with the mean value of 158.98 ±10.55 cm. Initial mean values of body weight (63.50 ± 8.83 kg), body mass index (25.15 ± 30.69),

mid upper arm circumference (26.52 ± 4.27 cm) and triceps skinfold thickness (20.74 ± 3.39 mm) were found to be reduced slightly after 60 days of experiment. In between at 30 days of experiment it was increased but after 60 days it was again decreased. In nutshell, it can be said that specific trend was not noticed in the anthropometric measurements of the subjects in control group. However, significant difference was noticed in the weight of the subjects between 30 and 60 days of experiment.

The average values of anthropometric measurements of the diabetic subjects of experimental group before (0 days) and after (30 and 60 days) supplementation are presented in Table 2. The mean value of body weight of the subjects of experimental group before supplementation was 67.64 ± 13.53 kg and it was ranged from 48.5– 90 kg whereas, after supplementation for 60 days it was 66.92 ± 13.04 kg. It was found that after 60 days of wheat grass supplementation the weight of the subjects of experimental group reduced significantly. The height of the experimental group was ranged from 147 - 179.5 cm with an average value of 160.22 ± 9.42 cm. The body mass index (BMI) of the subjects of experimental group was 26.38 ± 4.92, 26.21 ± 4.76 and 26.06 ± 4.72 at 0, 30 and 60 days of supplementation period, respectively. Results indicated that BMI of the subjects of experimental group decreased significantly ($p<0.05$) with the increase in period of supplementation.

The mean value of mid upper arm circumference of the experimental group before supplementation was 29.24 ± 3.58 cm whereas a slight decrease (29.06 ± 3.56 cm) was noticed after 60 days of supplementation of wheat grass powder. The average values recorded for triceps skin fold thickness of the subjects of experimental group before supplementation was 23.05 ± 3.51 mm which was decreased to 22.92 - 3.50 mm at 60 days of experiment. On the whole, the anthropometric

Table 1 : Anthropometric measurements of diabetic subjects of control group **(n=15)**

Parameters	Zero days		30 days		60 days	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Weight (kg)	48 - 77.6	63.50 ± 8.83	48.5 - 77.1	63.72 ± 8.65	48.1 - 76.8	63.4 ± 8.54
Height (cm)	145 – 179	158.98 ± 10.55	145 – 179	158.98 ± 10.55	145 – 179	158.98 ± 10.55
BMI	20.33 - 30.69	25.15 ± 2.96	20.54 - 30.49	25.24 ± 2.95	20.93 - 30.37	25.11 ± 2.89
Mid upper arm circumference (cm)	21.1 - 32.6	26.52 ± 4.27	21.3 - 32.4	26.57 ± 4.17	21.4 - 32.3	26.48 ± 4.16
Triceps skin fold thickness (mm)	16 - 27.4	20.74 ± 3.39	16.1 - 27.3	20.80 ± 3.36	16 - 27.1	20.71 ± 3.29

't' values of anthropometric measurements (students paired 't' test)

Days	Weight (kg)	Height (cm)	BMI	Mid upper arm circumference (cm)	Triceps skin fold thickness (mm)
Zero Vs 30	1.46NS	------	1.60NS	1.09NS	1.72NS
30 Vs 60	2.76*	------	2.99**	1.94NS	1.89NS
Zero Vs 60	0.54NS	------	0.50NS	0.58NS	0.57NS

NS=Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2 : Anthropometric measurements of subjects of experimental group before and after supplementation **(n=15)**

Parameters	Before supplementation Zero days		After supplementation 30 days		After supplementation 60 days	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Weight (kg)	48.5 – 90	67.64 ± 13.53	48.2 - 88.5	67.32 ± 13.22	47.8 - 87.8	66.92 ± 13.04
Height (cm)	147 - 179.5	160.22 ± 9.42	147 - 179.5	160.22 ± 9.42	147 - 179.5	160.22 ± 9.42
BMI	20.23 - 36.67	26.38 ± 4.92	20.12 - 35.90	26.21 ± 4.76	19.91 - 35.62	26.06 ± 4.72
Mid upper arm circumference (cm)	24.5 - 38.5	29.24 ± 3.58	24.1 - 38.2	29.12 ± 3.54	24.4 - 38.3	29.06 ± 3.56
Triceps skin fold thickness (mm)	16.5 - 28.3	23.05 ± 3.51	16.7 – 28	22.98 ± 3.49	16.8 - 28.1	22.92 ± 3.50

't' values of anthropometric measurements (students paired 't' test)

Days	Weight (kg)	Height (cm)	BMI	Mid upper arm circumference (cm)	Triceps skin fold thickness (mm)
Zero Vs 30	1.65NS	------	1.60NS	1.30NS	1.22NS
30 Vs 60	1.88NS	------	1.93NS	0.86NS	1.79NS
Zero Vs 60	2.35*	------	2.71*	2.03NS	2.06NS

NS=Non-significant *indicates significance of value at P=0.05

measurements such as weight (kg), body mass index, mid upper arm circumference and triceps skinfold thickness were found to be decreased after the supplementation of wheat grass powder for two months, but the significant difference was noticed only for weight and BMI values.

The mean values with SD of body weight (kg), height (cm), BMI, mid upper arm circumference (cm) and triceps skinfold thickness (mm) of the selected diabetic subjects of control and experimental group before and after experiment are presented in Table 3. Results indicated that after supplementation there was a significant decrease (from 26.38 ± 4.92 to 26.06 ± 4.72) in the BMI value of the subjects of experimental group. On the other hand, BMI value of the selected subjects of control group was also decreased from 25.15 ± 2.96 to 25.11 ± 2.89 after 60 days of experiment, but it was not significant. The average values of mid upper arm circumference and triceps skinfold thickness of the selected diabetic subjects of experimental group and control group was found to be decreased slightly which was not significant. In nutshell, the results indicated that supplementation of wheat grass powder for 60 days showed significant impact on body weight and body mass index of the subjects of experimental group whereas the difference between mid upper arm circumference and triceps skinfold thickness of the subjects of both the groups were not significant statistically.

Mean fasting and post prandial blood glucose level (mg/dl) of the selected diabetic subjects of control group at initial, 30th day and 60th day is presented in the Table 4. Mean values of fasting blood glucose level was 196.06 ± 50.92 mg/dl at initial which was slightly increased at 30th days and then decreased to 199.4 ± 54.55 mg/dl at 60th day of experiment. Similar trend was also noticed in case of post prandial blood glucose level. On the whole, it can be said that a significant difference was observed only in post prandial blood glucose level of the subjects of control group.

Mean values of fasting and post-prandial blood glucose of the selected diabetic subjects of experimental group is given in the Table 5. Average value of fasting blood glucose level of the selected diabetic subjects of experimental group was 192.13 ± 59.41 mg/dl at initial. A reduction was noticed in the blood glucose level after 30 days of experiment but this was not significant statistically whereas on 60th day, a significant reduction (179 ± 54.79 mg/dl) was observed. In case of post prandial blood glucose level, it was observed that 266.93 ± 81.47 mg/dl was mean initial value. It was decreased

Table 3: Anthropometric measurement of the subjects of experimental and control group before and after supplementation (n=30)

Anthropometric measurements	Selected diabetic subjects					
	Experimental group (n=15) supplementation		't' value	Initial	Control group (n=15)	
	Before (Initial)	After (60 days)			60 days	't' value
Weight (kg)	67.64 ± 13.53	66.92 ± 13.04	2.34*	63.50 ± 8.83	63.4 ± 8.54	0.54NS
Height (cm)	160.22 ± 9.42	160.22 ± 9.42	0.00NS	158.98 ± 10.55	158.98 ± 10.55	0.00NS
BMI	26.38 ± 4.92	26.06 ± 4.72	2.51*	25.15 ± 2.96	25.11 ± 2.89	0.50NS
Mid upper arm circumference (cm)	29.24 ± 3.58	29.06 ± 3.56	2.03NS	26.52 ± 4.27	26.48 ± 4.16	0.58NS
Triceps skin fold thickness (mm)	23.05 ± 3.51	22.92 ± 3.50	0.57NS	20.74 ± 3.39	20.71 ± 3.29	0.57NS

* indicates significance of value at P= 0.05 NS=Non-significant

Table 4 : Mean fasting and post-prandial blood glucose level of the subjects of control group

Days	Mean blood glucose level (mg/dl) of the selected diabetic subjects of control group			
	Fasting		Post prandial	
	Range	Mean ± SD	Range	Mean ± SD
Initial	124-300	196.06 ± 50.92	179-427	277.66 ± 81.54
30 days	116-290	202.73 ± 54.37	203-434	305.6 ± 68.47
60 days	98-277	199.4 ± 54.55	176-380	287.4 ± 70.21

't' values of fasting and post-prandial blood glucose level of control group

Days	Fasting	Post prandial
0 vs 30	0.89 NS	1.56 NS
30 vs 60	0.44 NS	2.20*
0 vs 60	0.29 NS	0.59 NS

NS=Non-significant * indicates significance of value at P=0.05

significantly at 30th day (255.86 ± 73.98 mg/dl) and at 60th day (244.86 ± 77.59 mg/dl) of supplementation. On the whole, results indicated that supplementation of wheat grass powder for 60 days had positive effect on reducing fasting and post prandial blood glucose level of the selected diabetic subjects of experimental group.

Mean fasting and post prandial blood glucose level (mg/dl) of the selected diabetic subjects of control and experimental and control group is given in Table 6. The average values of fasting blood glucose level of the selected diabetic subjects of experimental group was 192.13 ± 59.41 mg/dl at first day of experiment and it was remarkably decreased to 179.46 ± 54.79 mg/dl after 60 days of supplementation of wheat grass powder. On the other hand, mean fasting blood glucose level of the selected diabetic subjects of control group was increased slightly from 196.66 ± 50.92 mg/dl to 199.4 ± 54.55. Mean value of post prandial blood glucose level of the subjects of experimental group was found to be decreased significantly from 266.93 ± 81.47 mg/dl to 244.86 ± 77.59 mg/dl after 60 days of supplementation. On the contrary it was increased from 277.66 ± 81.54 mg/dl to 287.4 ± 70.21 mg/dl in the subjects of control group which was not significant statistically.

Reduction of postprandial blood glucose level is now considered a desirable goal for the control of diabetes mellitus. Even several research workers reported that supplementation of wheat grass have proved to be effective in the management of diabetes mellitus which is in line with the results of the present study. (Iyer *et al.*, 2010; Samagandi *et al.*, 2012; Shaikh and Quazi, 2012; Shakya *et al.*, 2012 and Chaturvedi *et al.*, 2013). Presence of phenolic compounds such as alkaloids, flavonoids, tannins, saponins, and sterols in *Triticum aestivum* can be attributed to their insulin-trophic effect that enables the reduction of blood glucose level of the diabetic. The possible mechanism of action of *Triticum aestivum* extract treated groups could be potentiating the pancreatic secretion of insulin from β-cells of islets, as was evident by significantly lowering the level of glucose (Shirwaikar *et al.*, 2006 and Chika and Bello, 2010).

Conclusion :

The results of the present study indicated that there was a significant reduction in body weight and BMI values of the selected subjects of experimental group. Further it was noticed that daily supplementation of 3 g wheat grass powder for 60 days found to have significant reduction in fasting and post prandial blood glucose level of the selected diabetic subjects. It may be due to its constituents like phenolic compounds such as alkaloids, flavonoids and tannins, saponins and sterols. Therefore, wheat grass powder having a therapeutic value can be used as natural antidiabetic product to control the prevalence of diabetes mellitus.

Acknowledgement :

The corresponding author express her sincere sense

Table 5 : Mean fasting and post-prandial blood glucose level of the subjects of experimental group

Days	Mean blood glucose level (mg/dl) of the selected diabetic subjects of experimental group			
	Fasting		Post prandial	
	Range	Mean ± SD	Range	Mean ± SD
Initial	125-351	192.13± 59.41	172-456	266.93± 81.47
30 days	122-355	187.53± 62.40	157-427	255.86 ± 73.98
60 days	119-316	179.46 ± 54.79	135-442	244.86 ± 77.59

't' values of fasting and post-prandial blood glucose level of the subjects of experimental group

Days	Fasting	Post-meal
0 vs 30	1.78^{NS}	2.61*
30 vs 60	2.98 **	2.81*
0 vs 60	3.38 **	4.14**

NS= Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 6 : Mean fasting and post prandial blood glucose level (mg/dl) of the selected diabetic subjects before and after supplementation (n=30)

Group	No.	Fasting		't' value	Post prandial		't' Value
		Initial	60 days		Initial	60 days	
Experimental	15	192.13± 59.41	179.46 ± 54.79	3.38 **	266.93± 81.47	244.86 ± 77.59	4.14**
Control	15	196.06 ± 50.92	199.4 ± 54.55	0.28 ^{NS}	277.66 ± 81.54	287.4 ±70.21	0.58 ^{NS}

NS=Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

of obligations and acknowledgement to the Department of Science and Technology (DST), Government of India for providing financial assistance received under the grant No.DST/INSPPIRE Fellowship/2012/257 in the form of DST-INSPIRE fellowship.

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Received : *04.03.2016;* **Revised:** *23.07.2016;* **Accepted :** *09.08.2016*