

# A comparative study on effect of nutrimix on elevated blood glucose levels – An experimental pre- post study

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■ **ABSTRACT :** In the present study hyperglycemic and hyperlipidemic subjects were supplemented with fibre and polyphenol rich nutrimix. The study was designed as comparative study between residents of 2 cities *i.e.* Vizag and Bhubaneswar, from each city 80 participants were selected in the age group of 40-60 years. The data relating to study was collected using questionnaire method. The product was supplemented as a part of their daily diet for a period of 6 months. Post analysis the result showed decrease in blood glucose and lipid levels of the participants. A significant improvement was found in blood glucose levels of type 2 diabetic subjects.

■ **KEY WORDS:** Nutrimix, Diabetes, Supplementation, Blood Glucose Levels

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Diabetes mellitus is a heterogeneous group of diseases characterized by chronic elevation of glucose in the blood. It arises because the body is unable to produce enough insulin for its own needs, either because of impaired insulin secretion, impaired insulin action, or both. Chronic exposure to high blood glucose is a leading cause of renal failure, visual loss and a range of other types of tissue damage. Diabetes also predisposes to arterial disease, it is often accompanied by hypertension, lipid disorders and obesity. Many cases of diabetes and almost all of its unwanted long-term consequences are potentially avoidable, but this will require intervention at a nutritional as well as at a medical level.

Type 2 diabetes mellitus is a fast growing disease

in the world. Many factors like age, sex, education, occupation, dietary pattern, type of life style, exercise, foods habits etc. play an important role in development of diabetes. The present study was undertaken in two cities *i.e.* Bhubaneswar and Visakhapatnam. The aim of our study was to bring into light improvement in blood glucose level in type 2 diabetes patients after supplementation with "Nutrimix" powder

## ■ RESEARCH METHODS

The present study was conducted in 2 cities of Vizag (Andhra Pradesh) and Bhubaneswar (Odisha), supplementation was done for over a period of 6 months. The study design was multi centered open- label, randomized, controlled parallel designed trial.

In the present study subjects were selected from diabetic clinic and fitness centre from both the cities. The criteria's of selection were that people having type II diabetes, diagnosed with diabetes for not more than 10 years, without any diabetic complications like neuropathy, nephropathy, cardiopathy and personal willingness of participation.

### Preparation of nutrimix:

In view of the fact that diets with high fibre and polyphenol content are good for blood sugar and lipid levels, the current study was undertaken to develop a nutrimix which could be used as a supplement for hyperlipidemic diabetic patients.

Before proceeding to the making of nutrimix the required ingredients were procured and processed as explained in the table given below :

The processed raw materials were mixed in a pre determined proportion, obtained through sensory evaluation of various blends.

Prior to supplementation the nutrimix was analyzed for shelf life, moisture content, fibre and phytonutrients.

The subjects from the experimental group were asked to consume 10 g nutrimix per day. The nutrimix was generally added to the food preparation like dals, chapati or it was taken as it is. The subjects in control group did not receive any supplementation. Blood glucose profile (FBG, PPBG and HbA1C) of subjects was collected on 0 day, 60<sup>th</sup> day, 120<sup>th</sup> day and 180<sup>th</sup> day. The obtained results from the blood test in both control and experimental group were analyzed using statistical tests

like mean, standard deviation, percentage and t-test.

## ■ RESEARCH FINDINGS AND DISCUSSION

For the present study recently diagnosed diabetics were selected, as they would respond better to the supplementation. In Vizag about 70-75 per cent subjects in both the groups were having diabetic since last -3 years. In Bhubaneswar group almost 50- 55 per cent subjects were having sugar from last 2-3 years.

Proceeding towards the changes in blood parameters shows us the following results:

### Blood glucose level:

#### *Fasting blood glucose level:*

Table 1(a) shows the changes in FBG during supplementation of nutrimix on Vizag experimental subjects it was seen that in age group 40-46 years in 6 months FBG dropped down by 12.4 per cent. Subjects aged between 47-54 years had mean FBG came down by 13.3 per cent in 6 months. In the oldest group of 55-60 years mean FBG by the end of 6 months was reduced by 11.6 per cent.

Table 1(a) indicates the FBG levels of control group in Vizag population. An increase of 2 per cent was seen in FBG levels by 2.0 per cent in 40-46 years age group. In 47-54 years age group decrease of 1.9 per cent was witnessed. In the eldest group a minor decrease of 0.93 per cent was seen in mean FBG levels.

In case of Bhubaneswar subjects as shown in Table 2(a) decrease was evident in all 3 age groups post supplementation. In 40-46 years age group and after 6

Age group	Initial FBG values (mg/dl)	2 months later values (mg/dl)	Change in (mg/dl)	Change in %	4 month later values (mg/dl)	Change in (mg/dl)	Change in %	6 month later values (mg/dl)	Change in (mg/dl)	Change in %	Total reduction in (mg/dl)
40-46	162±18.5	156.5±23.4	5.5	3.4	149±23.6	7.5	4.7	142.2±26.8	6.8	4.5	20.2(12.4%)
47-54	178±36.1	171.3±28.8	6.7	3.7	163.2±32.4	8.1	5.1	154.2±37.1	9	5.5	23.8(13.3%)
55-60	154±35.5	149.4±34.7	4.6	2.9	144±33.6	5.4	2.7	136.0±43.1	8	5.5	18(11.6%)

Age group	Initial FBG values (mg/dl)	2 months later values (mg/dl)	Change in (mg/dl)	Change in %	4 month later values (mg/dl)	Change in (mg/dl)	Change in %	6 month later values (mg/dl)	Change in (mg/dl)	Change in %	Total reduction/increase in (mg/dl)
40-46	132.15±19.75	130.5±14.83	1.65	1.26	133.8±12.3	3.3	2.46	137.6±13.44	3.8	2.7	↑5.45(2.0%)
47-54	141.3±42.9	137.7±43.6	3.6	2.16	137.2±39.0	0.5	0.36	138.6±37.4	1.4	1.01	↓2.7(1.91%)
55-60	160.0±55.7	153.8±52.7	6.2	4.03	169.3±44.7	15.5	9.15	158.5±47.7	10.8	6.81	↓1.5(0.93%)

months supplementation reduction of 11.3 per cent was seen. In 47-54 years age group mean FBG levels decreased by 17.1 per cent post supplementation. It was seen that in 55-60 years age group gradual decreased of 13.6 per cent was seen by the end of supplementation.

Change in FBG levels of control group from Bhubaneswar city is enumerated in Table 2(b). In 6 months among 40-46 yrs age group mean FBG decreased by 2.2 per cent. In remaining age groups a rise in blood sugar level was seen of about 4.5 per cent

and 3.4 per cent in 47-54 years and 55-60 years age group, respectively.

**Comparitive analysis of FBG levels of Vizag and Bhubaneswar experimental subjects post supplementation:**

When the data is compared it suggests that in 40-46 years age group in Vizag city the decrease in FBG was 12.4 per cent and among Bhubaneswar subjects it was 11.3 per cent. In the age bracket of 47-54 years

**Table 1(c) : Comparison of mean, standard deviation, T-value and P-value of between experimental and control groups, before and after supplementation**

Age group	N		Mean		t-value	p-value
	Expt	Control	Expt	Control		
40-46	E=24	0 day	162±18.5	132.1±19.7	3.89*	0.005
	C=8	180 <sup>th</sup> day	142.4±26.8	137.6±13.4	0.83**	0.4050
47-54	E=28	0 day	178±36.1	141.3±42.9	3.9**	0.0002
	C=64	180 <sup>th</sup> day	154.2±37.1	138.6±37.4	1.8 <sup>NS</sup>	0.68
55-60	E=28	0 day	154±35.5	160±55.7	0.36 <sup>NS</sup>	0.71
	C=8	180 <sup>th</sup> day	136±43.1	158.5±47.7	1.27 <sup>NS</sup>	0.21

NS=Non-significant; \*and \*\* indicate significance of p values at 0.01 and 0.05 levels, respectively

**Table 2(a) : Mean FBG of Bhubaneswar experimental group**

Age group	Initial FBG values (mg/dl)	2 months later values (mg/dl)	Change in (mg/dl)	Change in %	4 month later values (mg/dl)	Change in (mg/dl)	Change in %	6 month later values (mg/dl)	Change in (mg/dl)	Change in %	Total reduction in (mg/dl)
40-46	184.46±36.1	176.7±29.6	7.7	5.3	171.4±35.3	5.6	4.3	163.4±49.8	8.0	6.6	21.4(11.3%)
47-54	150.6±39.0	145.9±43.4	4.7	3.3	130±20.8	15.9	13	124.1±40.4	5.3	4.5	25.9(17.1%)
55-60	173.8±15.6	167.6±29.4	6.2	4.3	156.8±32.1	10.8	7.9	150.1±27.6	6.7	5.3	23.7(13.6%)

**Table 2(b) : Mean FBG of Bhubaneswar control group**

Age group	Initial FBG values (mg/dl)	2 months later values (mg/dl)	Change in (mg/dl)	Change in %	4 month later values (mg/dl)	Change in (mg/dl)	Change in %	6 month later values (mg/dl)	Change in (mg/dl)	Change in %	Total reduction / increase in (mg/dl)
40-46	132.5±18.8	131.9±17.5	0.6	0.79	132.5±20.18	0.6	0.4	135.5±20.9	3	2.21	↓3(2.26%)
47-54	139.8±33.72	140.6±33.4	0.8	0.56	136.2±38.49	4.4	3.2	144.3±37.7	8.1	5.61	↑4.5(3.21%)
55-60	152.3±39.28	154.9±38.7	2.6	1.67	155.2±37.4	0.3	0.19	155.7±34.4	0.5	0.32	↑3.4(2.2%)

**Table 2(c) : Comparison of mean, standard deviation, T-value and P-value of between experimental and control groups, before and after supplementation**

Age group	N		Mean		t-value	p-value
	Expt	Control	Expt	Control		
40-46	E=21	0 day	184.4±36.1	132.5±18.8	5.35*	0.0001
	C=17	180 <sup>th</sup> day	163.4±49.8	135.5±20.9	2.16*	0.0371
47-54	E=36	0 day	150.6±39	139.8±33.7	1.22**	0.2246
	C=33	180 <sup>th</sup> day	124.1±40.4	144.3±37.7	2.14**	0.0358
55-60	E=23	0 day	173.8±15.6	152.3±39.2	2.47**	0.0165
	C=30	180 <sup>th</sup> day	150.1±27.6	155.7±34.4	0.63 <sup>NS</sup>	0.5260

NS=Non-significant; \* and \*\* indicate significance of p values at 0.01 and 0.05 levels, respectively

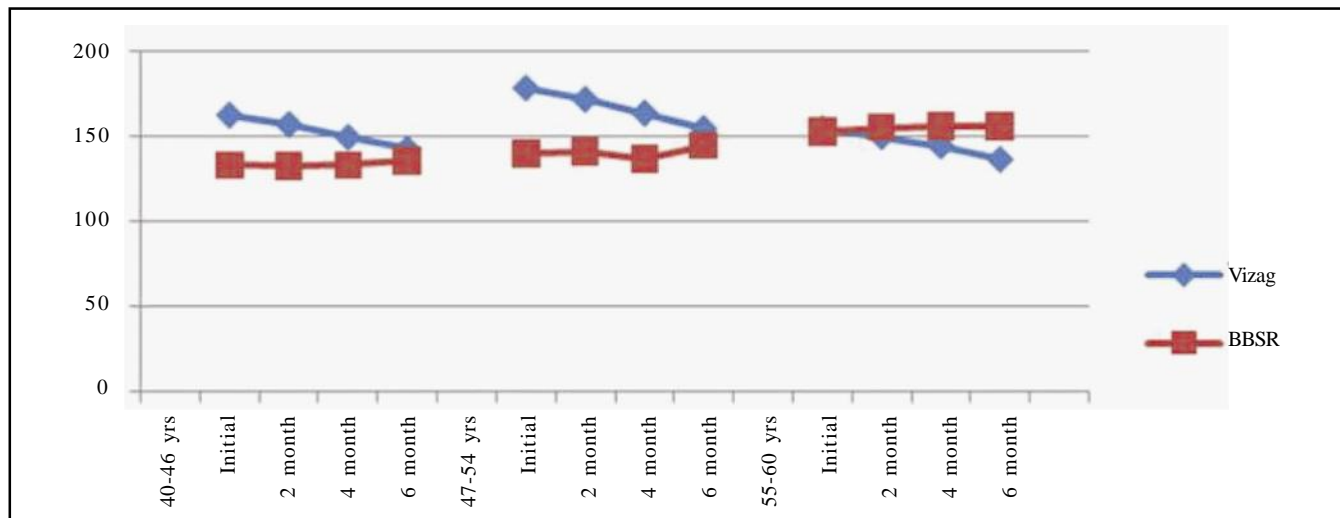


Fig. 1 : Comparative change in mean FBG levels of experimental group of both Vizag and Bhubaneswar subjects

decrease was 13.3 per cent and 17.1 per cent among Vizag and Bhubaneswar residents, respectively. In the oldest age group of 55-60 years mean FBG decreased by 11.6 per cent Vizag residents and it was 13.6 per cent in Bhubaneswar group.

According to a study by Surya *et al.* (2005) presence of cumin seeds in Nutrimix may have helped in reduction of FBG levels due to presence of anti oxidants which reduced oxidative stress caused by free radicals.

The above results are at par with study conducted by Zhang *et al.* (2013) on tender mango leaves where reduction in blood glucose level was seen due to presence of active metabolites of Benzophenone-c-glucoside, 3-

c-β glucoside and Foliamangiferoside in mango leaves.

**Post prandial blood glucose:**

The post prandial blood glucose levels of Vizag subjects is shown in Table 3(a). The data revealed that from mean PPBG values decreased by 15.3 per cent in 40-46 years age group. In 47-54 years age group the decrease was by 16.7 per cent. In the age group of 55-60 years mean PPBG reading was down by 16 per cent in 6 months of supplementation.

Table 3(b) shows that control group participants of Vizag city showed decrease in PPBG of 4.1 per cent and 3.5 per cent in 47-54 years age group and 55-60 years age group, respectively. In the youngest age group

Age group	Initial FBG values (mg/dl)	2 months later values (mg/dl)	Change in (mg/dl)	Change in %	4 month later values (mg/dl)	Change in (mg/dl)	Change in %	6 month later values (mg/dl)	Change in (mg/dl)	Change in %	Total reduction in (mg/dl)
40-46	235±18.5	227±24.4	7	3	216.3±39.1	10.7	4.9	199±	17.3	8.6	36(15.3%)
47-54	247±36.1	238.7±28.8	8.3	3.36	224.6±37.09	14.1	5.9	205.7±	18.9	8.4	41.3(16.7%)
55-60	241±35.5	232±32.7	8.2	3.4	220.4±34.7	12.4	5.6	202.3±	18.1	8.2	38.7(16%)

Age group	Initial FBG values (mg/dl)	2 months later values (mg/dl)	Change in (mg/dl)	Change in %	4 month later values (mg/dl)	Change in (mg/dl)	Change in %	6 month later values (mg/dl)	Change in (mg/dl)	Change in %	Total reduction in (mg/dl)
40-46	232±48.7	236±35.76	4.0	1.69	244.12±35.2	8.12	3.32	239.6±27.8	4.5	1.87	↑7.6(3.2%)
47-54	229.9±62.7	219.85±58.2	10.1	4.5	219.7±54.0	0.15	0.06	220.47±52.8	0.7	0.3	↓9.43(4.1%)
55-60	243±52.7	234.37±44.3	8.7	3.7	230.12±46.4	4.25	1.84	235.12±44.72	5.0	2.12	↓8.63(3.5%)

**Table 3(c) : Comparison of mean, standard deviation, T-value and P-value of between experimental and control groups, before and after supplementation**

Age group	N		Mean		t-value	p-value
	E	C	Expt	Control		
40-46	E=24	0 day	235±18.5	232±48.7	2.24**	0.0322
	C=8	180 <sup>th</sup> day	199±31.1	239.6±27.8	3.2*	0.0027
47-54	E=28	0 day	247±36.1	229.9±62.7	1.34 <sup>NS</sup>	0.1816
	C=64	180 <sup>th</sup> day	205.7±29.2	220.4±52.8	1.38 <sup>NS</sup>	0.1707
55-60	E=28	0 day	241±35.5	243±52.7	0.12 <sup>NS</sup>	0.9006
	C=8	180 <sup>th</sup> day	202.3±37.8	235.1±44.7	2.08**	0.0451

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

**Table 4(a) : Mean PPBG of Bhubaneswar experimental group**

Age group	Initial FBG values (mg/dl)	2 months later values (mg/dl)	Change in (mg/dl)	Change in %	4 month later values (mg/dl)	Change in (mg/dl)	Change in %	6 month later values (mg/dl)	Change in (mg/dl)	Change in %	Total reduction in (mg/dl)
40-46	217±27.9	209±31.2	8	3.6	196±46.7	9.0	4.3	187±29.0	9	4.1	26(11.9%)
47-54	229±41.2	220.5±32.1	8.5	3.7	214±36.9	6.5	2.9	201±33.6	13	6	28(12.2%)
55-60	223±25.6	216±40.3	7	3.1	205±23.8	9.5	4.4	194±30.8	11	5.3	27.5(12.3%)

**Table 4(b) : Mean PPBG of Bhubaneswar control group**

Age group	Initial FBG values (mg/dl)	2 months later values (mg/dl)	Change in (mg/dl)	Change in %	4 month later values (mg/dl)	Change in (mg/dl)	Change in %	6 month later values (mg/dl)	Change in (mg/dl)	Change in %	Total reduction in (mg/dl)
40-46	230±36.0	219.4±32.2	10.6	4.8	224.4±31.12	5	2.2	222.4±36.4	2	0.89	↓7.6(3.3%)
47-54	243.4±40.8	236±45.4	7.4	3.13	238.4±47.8	1.6	0.67	242.5±48.8	4.1	1.69	↓1.1(0.45%)
55-60	248.2±56.1	245.1±53.6	3.1	1.26	245.8±53.5	0.7	0.28	246.8±54.8	1	0.40	↓1.4(0.49%)

**Table 4 (c) : Comparison of mean, standard deviation, T-value and P-value of between experimental and control groups, before and after supplementation**

Age group	N		Mean		t-value	p-value
	E	C	Expt	Control		
40-46	E=21	0 day	217±27.9	230±36	1.25 <sup>NS</sup>	0.2177
	C=17	180 <sup>th</sup> day	187±29	222.4±31.1	3.62*	0.0009
47-54	E=36	0 day	229±41.2	243.4±40.8	1.45 <sup>NS</sup>	0.1498
	C=33	180 <sup>th</sup> day	201±33.6	242.5±48.8	4.14*	0.0001
55-60	E=23	0 day	223±25.6	248.2±56.1	1.99 <sup>NS</sup>	0.0511
	C=30	180 <sup>th</sup> day	194±30.8	246.8±54.8	4.14*	0.0001

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

*i.e.* 40-46 years 3.2 per cent rise in PPBG was seen.

Data about PPBG in Bhubaneswar group from Table 4(a) reveals that in 40-46 years age group in 6 months blood glucose level decreased by 11.9 per cent. In 47-54 years age group there was gradual decrease of 12.2 per cent. The oldest group of participants showed a decrease of 12.3 per cent in PPBG levels.

Table 4(b) elucidates change in PPBG levels of control group from Bhubaneswar which tells that there

was a negligible decrease of 0.4-0.5 per cent in mean PPBG levels in 47-54 and 55-60 years age group. Among 40-46 years age group mean PPBG decreased by 3.3 per cent.

**Comparitive analysis of PPBG levels of Vizag and Bhubaneswar experimental subjects post supplementation:**

The percentage decrease in PPBG levels in the

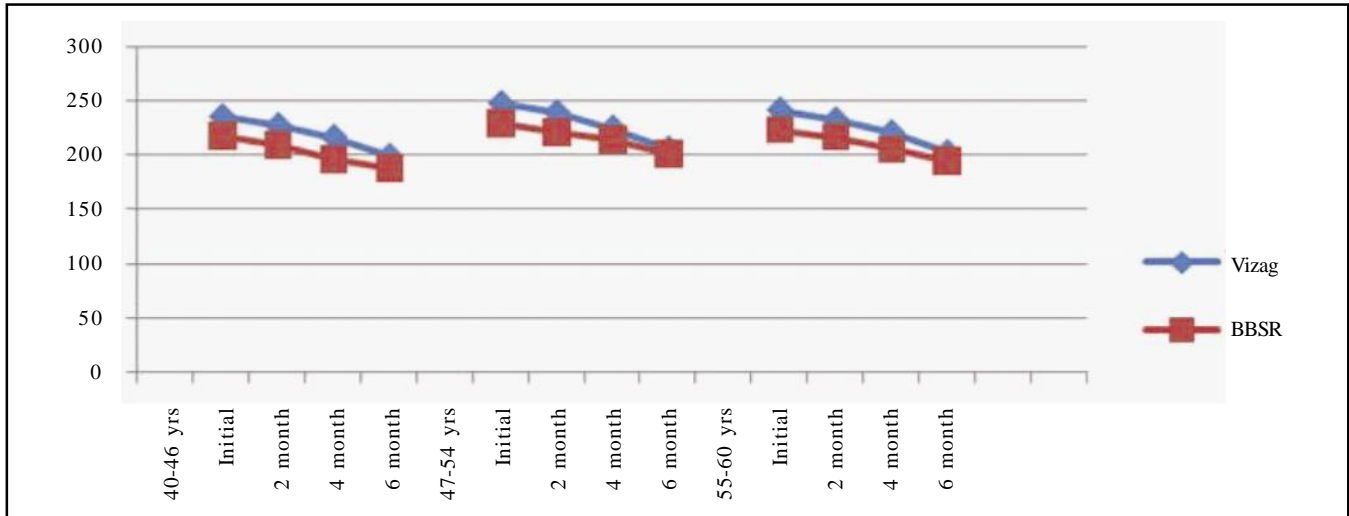


Fig. 2 : Comparative change in mean PPBG levels of experimental group of both Vizag and Bhubaneswar subjects

subjects of both the cities tells us that in Vizag among 40-46 years age group reduction in PPBG post supplementation was 15.3 per cent whereas in Bhubaneswar was 11.9 per cent. In both the remaining age groups *i.e.* 47-54 years and 55-60 years among Vizag residents 16-17 per cent reduction was seen and in Bhubaneswar group approximately 12 per cent reduction was seen. It can be seen that effect of Nutrimix on PPBG levels was much better in Vizag subjects.

The present result shows decrease in PPBG levels after supplementation as the major constituent of nutr mix is oats the results are at par with study conducted by Brateen *et al.* (1994) which proved that cell wall fibre of oat bran and oat gum lower PPBG as compared to wheat farina.

The presence of ragi may also be responsible for lowering of PPBG as stated by Shobana *et al.* (2013)

which says phenols in ragi inhibits amylase which in turn lowers PPBG.

Presence of tender Mango leaves in nutr mix improved glucose tolerance in glucose fed rats according to Srinivasan *et al.* (2004).

**HbA1C:**

Table 5(a) shows the improvement in HbA1C level of diabetic patients with supplementation of nutr mix. In Vizag group among 40-46 years old in 6 months HbA1C reduced by 21.2 per cent. In the age bracket of 47-54 years mean HbA1C post supplementation came down by 20.9 per cent. In 55-60 years age group mean HbA1C decreased by 14.5 per cent.

Table 5(b) shows changes in mean HbA1c levels of control group of Vizag, a sharp increase in mean HbA1c can be seen in all age groups. Around 9-10 per

Age group	Initial HbA1C values (%)	3 months later values (%)	Change	Change in %	6 month later (%)	Change	Change in %	Total reduction
40-46	9.4±0.9	8.7±0.9	0.7	7.4	7.4±1.0	1.3	14.9	2(21.2%)
47-54	10.5±1.4	9.3±1.3	1.2	11.4	8.3±1.2	1	10.7	2.2(20.9%)
55-60	9.6±1.2	9.1±1.1	0.5	5.2	8.2±1.1	0.9	9.8	1.4(14.5%)

Age group	Initial HbA1C values (%)	3 months later values (%)	Change	Change in %	6 month later values (%)	Change	Change in %	Total reduction
40-46	8.8±0.9	9.1±0.9	0.3	3.2	9.3±0.7	0.2	2.1	↑0.5(5.6%)
47-54	8.8±0.9	9.0±0.7	0.2	2.2	9.6±0.8	0.6	6.2	↑0.8(9.0%)
55-60	8.8±0.7	9.2±0.3	0.4	4.3	9.7±0.9	0.5	5.1	↑0.9(10.2%)

**Table 5(c) : Comparison of mean, standard deviation, T-value and P-value of between experimental and control groups, before and after supplementation**

Age group	N		Mean		t-value	p-value
			Expt	Control		
40-46	E=24	0 day	9.4±0.9	8.8±0.9	1.63 <sup>NS</sup>	0.1129
	C=8	180 <sup>th</sup> day	7.4±1.0	9.3±0.7	4.95*	0.0001
47-54	E=28	0 day	10.5±1.4	8.8±0.9	7.50*	0.0001
	C=64	180 <sup>th</sup> day	8.3±1.2	9.6±0.8	6.11*	0.0001
55-60	E=28	0 day	9.6±1.2	8.8±0.7	1.78 <sup>NS</sup>	0.0825
	C=8	180 <sup>th</sup> day	8.2±1.1	9.7±0.9	3.63*	0.0009

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

cent increase was seen in 47-54 years and 55-60 years age bracket. In 40-46 yrs age group it increased by 5.6 per cent.

In Bhubaneswar subjects among 40-46 years age group initial HbA1C reduced by 20.3 per cent post supplementation. In 47-54 years age group values decreased by 18.4 per cent. In the eldest group *i.e.* 55-60 years change was 17.1 per cent less.

Table 6 (b) shows changes in mean HbA1c levels among Bhubaneswar control group subjects. It can be seen that along all age groups negligible or no change has occurred.

**Comparitive analysis of HbA1C levels of Vizag and Bhubaneswar experimental subjects post supplementation:**

The changes in HbA1C values in both the cities shows that in 40-46 years age group the reduction was 21.2 per cent in Vizag group and 0.3 per cent in Bhubaneswar group. Among 47-54 years age group mean HbA1C levels reduced by 20.9 per cent and 18.4 per cent in Bhubaneswar group. Post supplementation least reduction was seen in 55-60 years age group in both the cities it was 14.5 per cent and 17.1 per cent in Vizag and Bhubaneswar, respectively.

**Table 6(a) : Mean HbA1C of Bhubaneswar experimental group**

Age group	Initial HbA1C values (%)	3 months later values (%)	Change	Change in %	6 month later values (%)	Change	Change in %	Total reduction
40-46	10.8±0.8	9.9±0.9	0.9	8.3	8.6±0.7	1.3	13.1	2.2(20.3%)
47-54	10.3±0.8	9.3±0.7	1	9.7	8.4±0.8	1.1	11.3	1.9(18.4%)
55-60	9.6±1.2	9.6±0.8	1.1	10.4	8.7±0.8	0.9	12.2	1.8(17.1)

**Table 6(b) : Mean HbA1C of Bhubaneswar control group**

Age group	Initial HbA1C values (%)	3 months later values(%)	Change	Change in %	6 month later values (%)	Change	Change in %	Total reduction
40-46	9.3±1.8	9.2±1.4	0.1	1.0	9.7±1.5	0.5	5.15	↑0.4(4.3%)
47-54	9.1±2.09	9.1±1.9	0	0	9.1±1.9	0	0	0(0%)
55-60	8.6±2.37	8.5±2.0	0.1	1.1	8.4±2.01	0.1	1.1	↓0.2(12.7%)

**Table 6(c) : Comparison of mean, standard deviation, T-value and P-value of between experimental and control groups, before and after supplementation**

Age group	N		Mean		t-value	p-value
			Expt	Control		
40-46	E=21	0 day	10.8±0.8	9.3±1.8	3.43*	0.0015
	C=17	180 <sup>th</sup> day	8.6±0.7	9.7±1.5	2.98*	0.0050
47-54	E=36	0 day	10.3±0.8	9.1±2.09	3.2*	0.0021
	C=33	180 <sup>th</sup> day	8.4±0.8	9.1±1.9	2.02**	0.0469
55-60	E=23	0 day	9.6±1.2	8.6±2.3	1.8 <sup>NS</sup>	0.0639
	C=30	180 <sup>th</sup> day	8.7±0.8	8.4±2.0	0.67 <sup>NS</sup>	0.5010

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

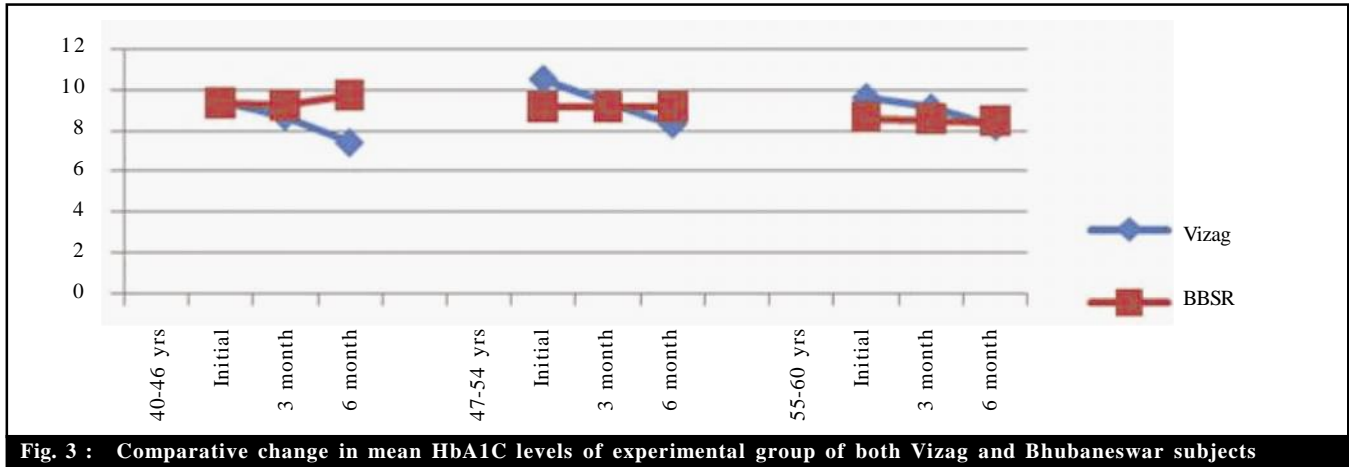


Fig. 3 : Comparative change in mean HbA1C levels of experimental group of both Vizag and Bhubaneswar subjects

Due to presence of Finger millets in nutrimix, reduction in HbA1C was seen which is at par with the results shown in a study by Shobhana *et al.* (2013) where around 33 per cent lower HbA1C was seen in experimental rat when fed with seed coat matter of finger millet.

The above results are at par with a study done by He *et al.* (2016) which compared the effectiveness of

$\beta$ -glucan extracted from different sources on blood parameters. Oats along with its bran decreased HbA1C and FBG as compared to  $\beta$ -glucan from barley.

In a study where ragi was supplemented for 3 months to diabetic patients it was seen that it decreased HbA1C post supplementation especially where it was > 7.5 (Joshi *et al.*, 2015).

Table 7(a) : Mean BMI of Vizag experimental group

Age group	Initial BMI	2 months later	Change	Change in %	4 months later	Change	Change in %	6 month later	Change	Change in %	Total reduction
40-46	27.93±3.5	25.4±3.1	2.5	8.9	24.1±2.9	1.3	5	22.2±2.5	1.9	7.8	5.4(19.3%)
47-54	28.9±2.8	27.3±2.6	1.6	5.5	26.0±2.4	1.3	4.7	24.6±2.1	1.4	5.3	4.3(14.8%)
55-60	29.1±2.6	27.3±2.5	1.8	6.1	25.6±2.2	1.7	6.2	24.7±1.9	0.9	3.5	4.4(15.1%)

Table 7(b) : Mean BMI of Vizag control group

Age group	Initial BMI	2 months later	Change	Change in %	4 month later	Change	Change in %	6 month later	Change	Change in %	Total reduction
40-46	24.8±3.8	25.4±3.4	0.6	2.3	25.6±2.9	0.2	0.78	25.7±2.5	0.1	0.38	0.9 (3.6%)
47-54	27.3±2.8	27.6±2.8	0.3	1.0	27.7±2.7	0.1	0.36	27.6±2.7	0.1	0.36	0.3 (1.0%)
55-60	25.9±3.3	26.5±3.3	0.6	2.26	26.3±3.2	0.2	0.59	26.4±3.2	0.1	0.37	0.5 (1.9%)

Table 7(c) : Comparison of mean, standard deviation, T-value and P-value of between experimental and control groups, before and after supplementation

Age group	N			Mean		t-value	p-value
	Expt	Control					
40-46	E=24	0 day		27.9±3.5	24.8±3.8	2.12**	0.0419
	C=8	180 <sup>th</sup> day		22.2±2.5	25.7±2.5	3.13*	0.0038
47-54	E=28	0 day		28.9±2.8	27.3±2.8	2.52**	0.0134
	C=64	180 <sup>th</sup> day		24.6±2.1	27.6±2.7	5.22*	0.0001
55-60	E=28	0 day		29.1±2.6	25.9±3.3	2.89*	0.0066
	C=8	180 <sup>th</sup> day		24.7±1.9	26.4±3.2	1.90 <sup>NS</sup>	0.0658

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



**Body mass index (BMI):**

Table 7(a) indicates changes in BMI in Vizag experimental group. In 40-46 years age group during 6 months supplementation mean BMI dropped by 19.3 per cent. Among 47-54 years old from reduced by 14.8 per cent. In 55-60 years age bracket mean BMI became

15.1 per cent less post supplementation.

It can be seen from the data in Table 7(b) that among Vizag control group slight increase in BMI was seen in all age groups. Around 3.6 per cent increase was seen in 40-46 years age group, 1-2 per cent increase was seen remaining 2 age groups.

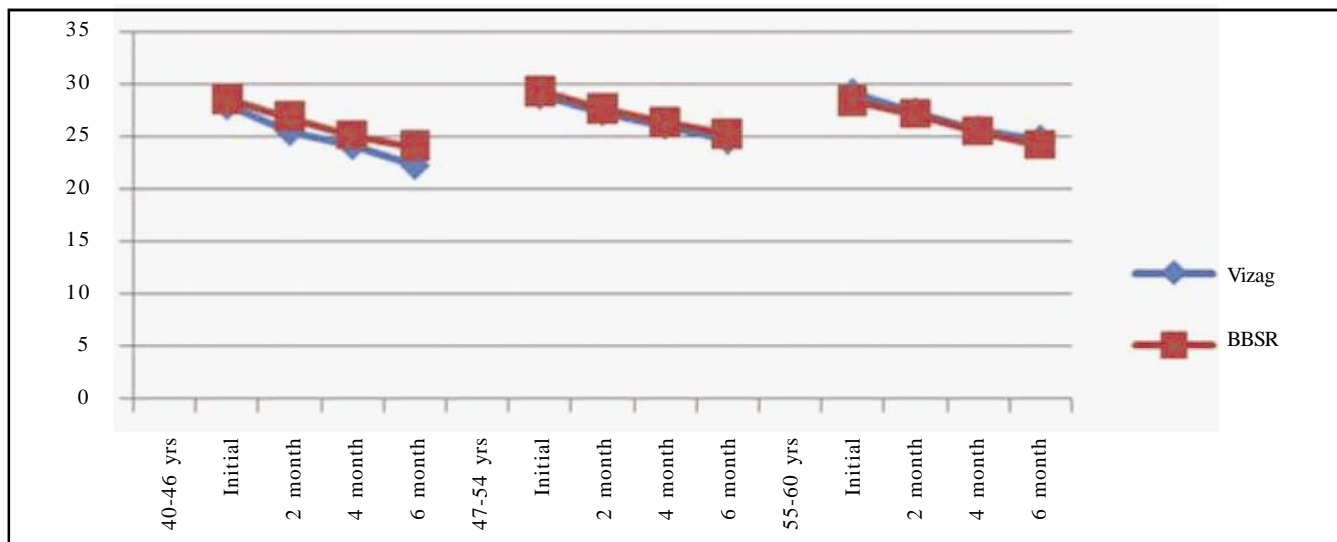


Fig. 4 : Comparative change in mean BMI levels of experimental group of both Vizag and Bhubaneswar subjects

Table 8(a) : Mean BMI of Bhubneswar experimental group

Age group	Initial BMI values	2 months later values	Change	Change in %	4 months later values	Change	Change in %	6 month later values	Change	Change in %	Total reduction
40-46	28.5±2.8	26.8±2.1	1.7	6.3	25.1±2.3	1.4	5.2	24.01±2.2	1.1	4.3	4.4 (15.4%)
47-54	29.3±2.5	27.6±3.1	1.7	5.8	26.3±2.1	1.3	4.7	25.2±3.9	1.1	4.1	4.1 (13.9%)
55-60	28.3±3.4	27.1±2.9	1.2	4.2	25.4±2.5	1.7	6.2	24.1±2.7	1.3	5.1	4.2 (14.8%)

Table 8(b) : Mean BMI of Bhubneswar control group

Age group	Initial BMI values	2 months later values	Change	Change in %	4 months later values	Change	Change in %	6 months later values	Change	Change in %	Total reduction
40-46	27.6±3.9	28.1±3.3	0.5	1.8	27.8±3.1	0.7	2.5	28.3±2.9	0.5	1.7	0.7(2.5%)
47-54	29.9±2.6	29.4±2.8	0.5	1.7	30.1±2.7	0.7	2.3	30.3±3.3	0.2	0.6	0.4(1.3%)
55-60	28.6±3.4	28.8±3.6	0.2	0.6	28.2±3.4	0.4	1.4	28.2±3.7	0	0	0.2(0.6%)

Table 8(c) : Comparison of mean, standard deviation, T-value and P-value of between experimental and control groups, before and after supplementation

Age group	N			Mean		t-value	p-value
	Expt	Control					
40-46	E=21	0 day		28.5±2.8	27.6±3.9	0.82 <sup>NS</sup>	0.4135
	C=17	180 <sup>th</sup> day		24.01±2.2	28.3±2.9	5.1*	0.0001
47-54	E=36	0 day		29.3±2.2	29.9±2.6	1.03 <sup>NS</sup>	0.3032
	C=33	180 <sup>th</sup> day		25.2±3.9	30.3±3.1	5.97*	0.0001
55-60	E=23	0 day		28.3±3.4	28.6±3.4	0.31 <sup>NS</sup>	0.7515
	C=30	180 <sup>th</sup> day		24.1±2.7	28.2±3.7	4.47*	0.0001

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

Table 8(a) indicates the decrease in mean BMI among Bhubaneswar subjects after supplementation. In the youngest age group *i.e.* 40-46 years age group it was seen that BMI decreased by 15.4 per cent. In 47-54 year old BMI came down by 13.9 per cent among 55-60 year old subjects it was down by 14.8 per cent.

Table 8(b) shows that apart from a very slight decrease of 0.6 per cent in 55-60 years age group rest of the participants showed increase in BMI by 2.5 per cent in 40-46 yrs age group and 1.3 per cent in 47-45 year's age bracket.

### Comparitive analysis of BMI levels of Vizag and Bhubaneswar experimental subjects post supplementation:

Here good reduction in BMI can be seen from subjects of both the cities. In 40-46 years subject's 19.3 per cent reduction was seen in Vizag group and it was 15.4 per cent among Bhubaneswar residents. In 47-54 years age group the percentage reduction was very close in both the cities about 13-14 per cent. Among 55-60 years age group reduction was 15.1 per cent in Vizag and 14.8 per cent in Bhubaneswar.

Presence of Mango leaf in the Nutrimix assists in the weight loss of the subjects according to Moreno *et al.* (2005). They discovered that mango leaf extract increases fecal fat excretion and down regulated some obesity related genes in liver epidermal fat.

### Conclusion:

On the basis of improvement in sugar levels post supplementation it can be concluded that Nutrimix has significant hypoglycemic effect on type 2 diabetic subject. Lowering of blood glucose and HbA1c was due to presence of fiber and phytochemical in each ingredients of the nutrimix. Hence such indigenously prepared nutrimix with easily available ingredients help in controlling blood sugar levels and its further complications.

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