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Impact of Indigenous Fibre Rich Premix Supplementation on Blood Glucose Levels in Diabetics

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Abstract: A premix, containing different proportion of locally available ingredients namely wheat, bengal gram, dried peas, defatted soyflour, barley and fenugreek seeds, was administered to 30 NIDDM subjects, equal number of both sexes to find out the impact of administering indigenous fibre rich therapeutic premix on blood glucose levels. The study was conducted in Amritsar city, India. The premix was given during breakfast in the form of chapattis for 90 days without disturbing the daily dietary pattern of the selected diabetic subjects. The study revealed that there was a significant reduction in fasting and post prandial blood glucose levels after 90 days of the premix supplementation. After the premix supplementation, the dose of oral hypoglycaemic drug was also reduced. All the subjects reported that there was decrease in the diabetic symptoms experienced by them at the end of the period of premix supplementation. The study thus indicated that the blood glucose level in diabetic patients could be reduced efficiently and gradually through the daily intake of less expensive premix, which can be easily prepared at home.

Key words: NIDDM, premix supplementation, fasting blood glucose, post prandial blood glucose

INTRODUCTION

Diabetes is the single most important metabolic disease, widely recognized as one of the leading cause of death and disability worldwide (Pradeepa and Mohan, 2002). It was declared that diabetes has reached epidemic proportions and predicted that most of the increase will be contributed by developing countries particularly India. The United Nations World Health Organization (WHO) warned that the number of diabetes cases across the developing world could more than double over the next 30 years. It is also estimated that the number of diabetes cases in developing nations will rise from 115 million in 2000 to a forecast of 284 million in 2030 (Anonymous, 2003). As per the National Urban Diabetes Survey (NUDS) India, the prevalence of diabetes in the major cities of India was 11.6% in New Delhi, 13.5% in Chennai, 12.4% in Bangalore, 16.6% in Hyderabad, 11.7% in Kolkata and 9.3% in Mumbai (Pradeepa and Mohan, 2002) and about more than 90% of the diabetes patients in India suffer from NIDDM.

Despite of considerable progress in the management of diabetes mellitus by synthetic drugs, the search for indigenous natural antidiabetic is still in the experimental stage. Number of studies (Meyer *et al.*, 2000; Kavita *et al.*, 2001; Fedheim and Wisker, 2002) indicated that high fiber diets has beneficial impact in lowering the blood sugar levels, hence reducing the risk of diabetes. Treatment with a decoction of fenugreek seeds has reported to suppress glycosuria in mild diabetes and bring about improvement in severe diabetic condition. This is due to the water soluble alkaloid called Trigonelline,

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which is present in fenugreek seeds (Kinsky *et al.*, 1967). Similarly, soy isoflavones are beneficial for diabetic subjects because of their estrogenic activity and their ability to prevent glucose uptake by decreasing sodium dependent glucose transporter, which results in a reduction in post prandial hyperglycemia (Vedavanam *et al.*, 1999). Sai Priya and Magheshwari (1998) observed a significant decrease in fasting and post prandial blood glucose levels in NIDDM with the supplementation of a premix containing dry peas, whole bengal gram, whole green gram, horse gram and rice in a period of 30 days. A number of studies demonstrated the glucose lowering effect of different foods but the information on the effect of supplementation of premix, containing various commonly available foods or ingredients, for a considerable period, is not available in the literature. Therefore, the present study was undertaken with the objective to find out the impact of indigenous fibre rich premix supplementation on blood glucose levels of non-insulin dependent diabetes mellitus patients for a period of 90 days.

MATERIALS AND METHODS

Thirty NIDDM (non insulin dependent diabetes mellitus) patients equal number of both sexes, aged between 41-50 years from middle income group were selected with the help of medical practitioners for this study. The study was carried out in the Amritsar city of Punjab state of India in 2005. The criterion for selection of the diabetic subjects was their blood glucose levels. Subjects suffering from any other disease or serious complications were excluded from the final study sample. Six commonly available ingredients namely wheat, bengal gram, dried peas, defatted soyflour, barley and fenugreek seeds were used for preparation of the premix. The premix was prepared as per the standardized procedure (Kang, 2005). The percentage of wheat, bengal gram, dried peas, defatted soyflour, barley and fenugreek Seeds in the premix was 67.5, 10, 10, 7.5, 2.5, 2.5%, respectively. This premix was administered in one meal (preferably breakfast) in the form of chapattis for 90 days without disturbing the daily dietary pattern of the selected diabetic subjects. A survey was conducted to collect the background information, family history and the information related to disease. The subjects were enquired about the family history of diabetes and also about the various symptoms related to diabetes, experienced by the subjects viz. polydipsia, polyuria, polyphagia etc. Dose of oral hypoglycaemic drugs prescribed to the respondents was also recorded. Biochemical parameters namely blood glucose; both fasting blood glucose and post prandial blood glucose levels (2 h after meal) were recorded before, after 45 and 90 days of premix supplementation (Trinder, 1969). The data was statistically analyzed and interpreted using student's t-test (Singh *et al.*, 1998).

RESULTS AND DISCUSSION

Background Information

From the study, it is evident that majority (80% male and 87% female) of the selected diabetic patients belonged to age group of 41-50 years, the period when the incident of diabetes is precipitated. About 70% study subjects had a positive family history with father (17%) or mother (43%) or either brother (17%) or sister (7%), or offspring (3%) or grandparents (7%) or uncle/ aunt (3%) suffering from the disease. Out of the total selected subjects, 93% male and 80% female were leading a sedentary life style and rest of them were doing moderate activities. As none of the selected subjects was engaged in heavy work, it indicated that sedentary life style might be one of the risk factors for the development of NIDDM in the study subjects. Most common symptoms amongst the selected diabetic subjects (Table 1) were tiredness (73%), polydipsia (60%), polyphagia (47%), burning sensation under feet (40%) and headache (37%).

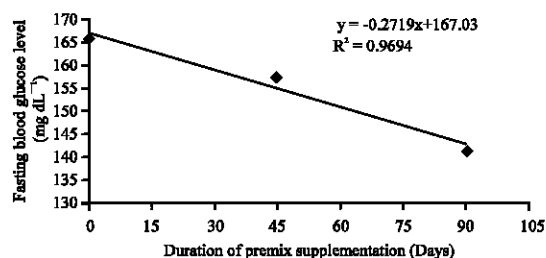


Fig. 1: Effect of premix supplementation (after 0, 45 and 90 days) fasting blood glucose levels of diabetics

Table 1: Signs and symptoms of diabetes among study subjects

Symptoms	Diabetic study subjects*		All subjects (n = 30)
	Male (n ₁ = 15)	Female (n ₂ = 15)	
Polydypsia	8 (53.33)	10 (66.67)	18 (60.00)
Polyuria	4 (26.67)	5 (33.33)	9 (30.00)
Polyphagia	6 (40.00)	8 (53.33)	14 (46.67)
Burning sensation under feet	4 (26.67)	8 (53.33)	12 (40.00)
Excessive sweating	5 (33.33)	5 (33.33)	10 (33.33)
Itching	5 (33.33)	5 (33.33)	10 (33.33)
Headache	6 (40.00)	5 (33.33)	11 (36.67)
Delayed healing	--	1 (6.67)	1 (3.33)
Nocturia	4 (26.67)	3 (20.00)	7 (23.33)
Tiredness	12 (80.00)	10 (66.67)	22 (73.33)
Weight loss	2 (13.33)	1 (6.67)	3 (10.00)
Drowsiness	5 (33.33)	2 (13.33)	7 (23.33)

*: Multiple responses; Values in parenthesis indicate percentages

Fasting Blood Glucose Levels

Blood glucose is the useful index of the overall nutritional status irrespective of its significant role in diabetes mellitus. The fasting blood glucose levels in healthy individuals vary between 80-110 mg dL⁻¹ (Raghuram *et al.*, 1998). Fasting blood glucose levels of the study subjects just before the start of premix supplementation, after 45 and 90 days of premix supplementation are shown in Fig. 1. Various studies (Rao and Ramulu, 1998; Kristin *et al.*, 1999; Anonymous, 2001) revealed the impact of high fibre diets rich in soluble fibre in reducing the blood glucose levels. This study revealed that 87% diabetic subjects had the fasting blood glucose level >140 mg dL⁻¹ before the premix supplementation started, which decreased to 53% after 90 days of premix supplementation. After premix supplementation, the percentage of subject with fasting blood glucose level between 111-140 mg dL⁻¹ increased from 13 to 43%, while 3% diabetics were observed in the normal category range i.e., the fasting blood glucose level 80-110 mg dL⁻¹. The premix supplementation for 45 days reduced the fasting blood glucose values significantly ($p < 0.01$) from 170.53 to 160.77 mg dL⁻¹ in male study subjects but the reduction in fasting blood glucose level from 161±5.13 to 147.37±7.07 mg dL⁻¹ in female subjects was non significant (Table 2). After 90 days of premix supplementation, there was significant ($p < 0.01$) reduction in fasting blood glucose level in both male and female study subjects. The presence of fenugreek seed powder in the premix can be the major contributing factor in reducing the fasting blood glucose in the study subjects because it contains trigonelline, an alkaloid, which is known to reduce the blood sugar level (Raghuram *et al.*, 1993). The effectiveness of supplementation of soaked fenugreek seed in the reduction of fasting blood glucose levels from 151.5 to 141.4 mg dL⁻¹ after 60 days supplementation had also been proved in a study carried out by Amirthaveni and Thirumanidevi (2004) and Habori and Raman (1998).

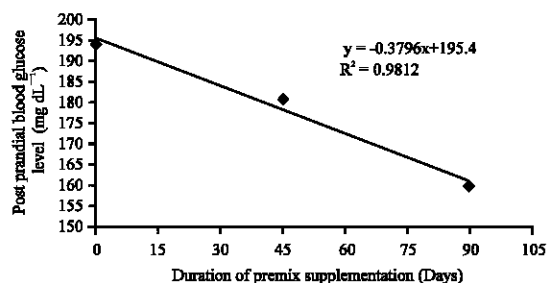


Fig. 2: Effect of premix supplementation (after 0, 45 and 90 days) on post prandial blood glucose levels

Table 2: Fasting and post prandial blood glucose levels of study subjects before and after premix supplementation

Particulars	Blood glucose level (mg dL ⁻¹)			t-value [#]	t-value ^{###}	t-value ^{###}
	Before supplementation	After 45 days supplementation	After 90 days supplementation			
Male (n ₁ =15)						
Fasting blood glucose levels	170.53±4.40	160.77±4.29	143.87±04.66	1.599***	4.16**	2.67*
Post prandial blood glucose levels	202.33±15.68	191.53±14.09	165.13±15.36	0.57 ^{NS}	1.57***	1.00 ^{NS}
Female (n ₂ =15)						
Fasting blood glucose levels	161.00±5.13	147.37±7.07	138.73±3.74	0.99 ^{NS}	3.50*	2.51**
Post prandial blood glucose levels	179.07±13.24	170.20±10.40	148.00±9.74	1.00 ^{NS}	2.60**	1.62**

*, p<0.01, **, p<0.05, NS: Non Significant, ***, p<0.001, #: Before and after 45 days premix supplementation, ###: Before and after 90 days premix supplementation, ####: After 45 and after 90 days premix supplementation

Post Prandial Blood Glucose Levels

The post prandial (2 h after meal) blood glucose levels of study subjects, just before the start of premix supplementation, after 45 and 90 days of premix supplementation was presented in (Fig. 2). After 45 days of premix supplementation, a slight but insignificant reduction in post prandial blood glucose level was observed. The 90 days premix supplementation was found beneficial and showed a significant reduction in the post prandial blood glucose levels (Fig. 2). Similar finding was also observed by Amirthaveni and Thirumanidevi (2004) with fenugreek supplementation for a period of 90 days. Bengal gram, dried peas and soybean present in the premix supplemented to study subjects, due to low glycemic effects, might had exerted an impact in lowering the post prandial blood glucose levels as also observed by Rao (1988), Mann (1997), Sai and Uma (1998) and Vedavanam *et al.* (1999). Although no significant reduction in post prandial blood glucose level was observed in the study subjects after 45 days of the premix supplementation but the premix supplementation for 90 days was found effective in both male and female study subjects (Table 2).

The study revealed that before the premix supplementation, 43% subjects (40% males, 47% females) had post prandial blood glucose level >200 mg dL⁻¹, which decreased to 7% after premix supplementation in 90 days period (Table 3). Similar findings were also observed by Chadha *et al.* (1998). The increase in the number of normal study subjects with the indigenous fibre rich premix supplementation for 90 days period has proved that with some modification in the diet of diabetics by incorporating the foods like bengal gram dried peas, soybean, barley and acceptable amount of fenugreek seed with the staple food like wheat, in the daily diet of diabetics, the doses of hypoglycemic drugs can be reduced and the condition of diabetics can be improved.

Oral Hypoglycaemic Drug Intake Before and after Premix Supplementation

Most commonly prescribed Oral Hypoglycemic Drugs (OHD) to the study subjects were Dianil and Rebuse. There was an increase from 10 to 33.33% and 16.67 to 30% among the subjects taking

Table 3: Distribution of study subjects on basis of blood glucose levels before and after 90 days of premix supplementation

Particulars	Blood glucose level (mg dL ⁻¹)					
	Male (n ₁ = 15)		Female (n ₂ = 15)		All subjects (n=30)	
	Before*	After*	Before*	After*	Before*	After*
Fasting blood glucose level						
> 140	14 (93.33)	9 (60)	12 (80)	7 (46.67)	26 (87)	16 (53)
111-140	1 (6.67)	5 (33.33)	3 (20)	8 (53.33)	4 (13)	13 (43)
80-110 [#]	--	1 (6.67)	--	--	--	1 (3)
Post prandial blood glucose level						
> 200	6 (40)	2 (13.33)	7 (46.67)	--	13 (43)	2 (7)
161-200	4 (26.67)	6 (40)	2 (13.33)	7 (46.67)	6 (20)	13 (43)
120-160 ^{###}	5 (33.33)	6 (40)	6 (40)	4 (26.67)	11 (37)	10 (33)
<120	--	1 (6.67)	--	4 (26.67)	--	5 (17)

Values in parentheses indicate percentage; *: Premix supplementation; #: Normal range; ###: Normal range

0.5 and 1.0 tablet/day, respectively after 90 days of premix supplementation. On the other hand, a decrease from 30 to 20% and 43.33 to 16.67% was observed in subjects taking 1.5 and 2 tablets day⁻¹, respectively. Decrease in intake of OHD may be attributed to decrease in blood glucose levels, which was due to regular intake of the premix during the study period. The demand of the supplied premix by the study subjects, even after the completion of the study because of the significant reduction in the blood glucose levels during the study period, showed the market potential of this premix.

CONCLUSIONS

The study revealed that there was a significant reduction in fasting and post prandial blood glucose levels amongst the study subjects after 90 days of indigenous fiber rich premix supplementation in the form of *chapattis* in the breakfast. The study proved that the blood glucose level in diabetic patients could be reduced efficiently and gradually through the daily intake of less expensive premix, which can be easily prepared at home. After premix supplementation, percentage of subjects taking higher dose of oral hypoglycaemic drug was reduced. All the subjects reported that there was decrease in the diabetic symptoms experienced by them at the end of the 90 days period of the premix supplementation. The demand of the supplied premix by the study subjects, even after the completion of the study because of the significant reduction in the blood glucose levels during the study period, showed the market potential of this premix. Therefore, the premix containing wheat, bengal gram, dried peas, defatted soyflour, barley and fenugreek seeds at 67.5, 10, 10, 7.5, 2.5, 2.5%, respectively, may be prescribed to diabetic patients and private agencies should come forward and take up initiative to manufacture this type of premix and make them available in the market for diabetics.

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