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Development and Supplementation of Fibre Enriched Formulated Supplementary Mixture on Type 2 Diabetes Mellitus

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Abstract: ***Diabetes mellitus (DM) is a metabolic disorder resulting from a defect in insulin secretion, insulin action, or both. Insulin deficiency in turn leads to chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism. The present research was carried out to determine the effect of supplementation of developed fibre enriched supplementary mixture and to compare it with a commercially available diabetic supplementary mixture among diabetic adults aged 40 to 60 years for a period of 60 days. The nutrient analysis, sensory evaluation and shelf life of the formulated product were analysed and compared with a commercially available product. The ingredients selected for the development of fibre enriched supplementary mixture were among the cereals, pulses, nuts &oil seeds and spices & condiments.***

Keywords: NIDDM-GI-Dietary fibre-Supplementation.

1. Introduction

Diabetes mellitus is a group of diseases associated with various metabolic disorders, the main feature of which is chronic hyperglycaemia due to insufficient insulin action. Its pathogenesis involves both genetic and environmental factors. The long-term persistence of metabolic disorders can cause susceptibility to specific complications and also foster arteriosclerosis. Diabetes mellitus is associated with a broad range of clinical presentations, from being asymptomatic to ketoacidosis or coma, depending on the degree of metabolic disorder [1].

In India, cereals and pulses form the staple diet. Pulses are particularly rich in their fiber content. Lentils and pulses have a low glycemic index (GI). Mixed meals of different carbohydrate foods exhibit a GI which is intermediate between the GI of each food individually although some investigators were unable to corroborate this finding [2]. The within-individual variation was found to be large in IDDs [3].

Consumption of a number of grains and grain extracts has been reported to control or improve glucose tolerance and reduce insulin resistance. The inability of the body to maintain normal glucose levels or to require excessive levels of insulin to do so has been called glucose intolerance, impaired glucose tolerance and insulin resistance. These conditions are associated with obesity and may be preliminary steps in the progression to type 2 diabetes mellitus [4].
Pulses have a low glycemic index, making them excellent sources of carbohydrate in the diet of those affected by diabetes [5]. Including pulses in the diet helps control blood glucose and insulin levels. Pulses have other health effects, like reducing blood lipids. This may help prevent some serious complications of diabetes [6].

Numerous studies indicate high-fat diets can impair glucose tolerance and promote obesity, dyslipidemia and atherosclerotic heart disease. Research also shows these same metabolic abnormalities are reversed or improved by reducing saturated fat intake [7].

Foods those are rich in fibre can reduce the rate of glucose absorption, lower blood glucose rise, decrease urinary glucose excretion, slower stomach emptying and delay intestinal transit time. Fiber also contributes to satiety and consequent decreased food intake helps reduce weight. This fiber containing complex carbohydrates that are slowly digested and absorbed such as pulses, brown rice, bread, chapathy will produce fewer rises in blood glucose and less excretion of urinary glucose than an equivalent amount of carbohydrates taken as sugar in tea. The fiber particularly the gums, pectin's when ingested with a diet are reported to reduce post prandial glucose levels in blood. Studies have shown that gum present in fenugreek seeds is most effective in reducing blood glucose and cholesterol levels as compared to other gums. These types of dietary fiber are often recommended for the management of certain types of diabetes [8].

Approximately 10 to 20 per cent of the calories will be from protein. Unless the individual makes a concentrated effort to restrict protein, this percentage will generally be closer to 20%. The remainder of the calories will be divided between fat and carbohydrate, based on the nutrition assessment and treatment goals. It is generally agreed that <10% of the daily calories should be from saturated fat and <300 mg from dietary cholesterol [9]. There is no evidence that carbohydrate from sugars is more rapidly digested and absorbed and thereby aggravates hyperglycemia, compared to carbohydrate from starch [10]. From a clinical standpoint, it is the total amount of carbohydrate consumed that affects blood glucose levels, not the source [11]. Thus, individuals can be taught to substitute foods containing sucrose for other carbohydrates (starch, fruit, or milk) in their meal plan.

Chromium supplementation in a study conducted by Mahdi and Naismith [12], 1991 was followed by immediate and successful improvement in diabetic patients. Diets high in processed foods have negative effects on the amount to chromium in the body's systems. When foods are processed they lose sufficient amounts of chromium supplied from growth in chromium-rich soil. Chromium participates in metabolism by way of the glucose tolerance factor that increases the action of insulin in the body. Chromium dinicotinic acid-gluathione complex increased the action of and response of insulin in certain metabolic pathways. Chromium in its active form in the body glucose tolerance factor, removes glucose from the blood to use as energy within the cells.

2. Materials and Methods

The present research was carried out to determine the effect of supplementation of developed fibre enriched supplementary mixture and to compare it with a commercially available diabetic supplementary mixture among diabetic adults aged 40 to 60 years for a period of 60 days. The nutrient analysis, sensory evaluation and shelf life of the formulated product was analysed and compared with a commercially available product.

The ingredients were used for the development of fibre enriched supplementary mixture were selected based on their nutrient composition and any allergens present in it. Among the food groups, rice and barley in the ratio of 1.2 : 2.5 respectively were incorporated, in pulses whole bengalgram, soy bean and rajmah in the ratio of 1 : 2 : 1 respectively were incorporated, in nuts and oil seeds almond and gingelly seeds in the ratio of 0.5 : 0.5 respectively and in condiments and spices 2g of fenugreek seed and small quantity of sunflower oil (3ml) were incorporated. For the enrichment of fiber, 10g of psyllium husk were incorporated.

24 samples were selected based on the inclusion criteria and they were divided into 3 groups respectively. Experimental group I who received fibre enriched formulated supplementary mixture, experimental group II who received commercially available supplementary mixture and Control group who do not receive any supplementation.

3. Results and Discussion

The nutrient analysis of fibre enriched formulated supplementary mixture and commercially available supplementary mixture were depicted in the Table I. It shows that the amount of energy and fat are higher in commercially available supplementary mixture and the amount of carbohydrates and proteins are higher in fibre enriched of formulated supplementary mixture.

The result shows that the subjects in the experimental group I, experimental group II and control group had significant difference on their fasting blood glucose level and post prandial blood glucose level after consuming the fibre enriched formulated supplementary mixture and were depicted in the table 2. The data reveals that there were significant differences at all level of 1% significance on fasting blood glucose level and post prandial blood glucose level after consuming the fibre enriched formulated supplementary mixture.

4. Conclusion

The present research revealed that there was significant reduction of 1per-cent level of significance in post prandial blood glucose of experimental group I. Whereas in experimental group II and control group were found to be 1 per-cent significant increment in post prandial blood glucose. Therefore the developed fibre enriched supplementary mixture reduces the post prandial blood glucose at 1 per-cent significant level. Hence the diabetic individual can focus on the incorporation of formulated fibre enriched supplementary mixture and can include in their daily diet.

Table 1: Nutrient analysis of fibre enriched formulated supplementary mixture

S.No	Nutrients	Nutritive value per 100g	
		Fibre enriched formulated supplementary mixture	Commercial supplementary mixture
1	Energy (kcals)	402.29	435
2	Carbohydrate (g)	65.66	59.8
3	Protein (g)	24.33	20.1
4	Fat (g)	4.715	14.6
5	Fibre (g)	4.09	5.2
6	Chromium (mcg)	0.93	25.5
7	Selenium (mcg)	2.34	16.4
8	Sodium (mg)	123.45	324
9	Potassium (mg)	34.67	565

Table 2: Blood glucose levels of the subjects before and after the supplementation of the fibre enriched formulated supplementary mixture

Variable	*Mean ± SD*		*'t' value*	*Level of significance*
	Initial	*Final*		
Experimental Group I				
FBG	170.75 ± 55.26	173 ± 92.97	0.70	1%
PPG	246.25 ± 119.72	228 ± 82.56	1.45	1%
Experimental Group II				
FBG	198.37 ± 51.20	198.5 ± 49.0	0.00	1%
PPG	291.75 ± 78.11	324.75 ± 68.85	1.11	1%
Control Group				
FBG	235.62 ± 90.97	224.87 ± 79.60	0.67	1%
PPG	323.5 ± 106.30	341.12 ± 107.27	1.05	1%

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