



Summary and Conclusion

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Diabetes mellitus is a silent killer disease and not recognized as one of the fastest growing threats to public health in almost all the countries of the world, with serious consequences. Diabetes mellitus is characterized by high blood glucose concentration resulting from the defects in insulin secretion, liberation and action, or the combination. This disease is incurable but it is controllable and offers hope to life.

Diabetes being the second cause of death in world population, the growing monetary rate of drugs to stabilize the sugar levels and the growing population is unable to reach the cure for diabetes have now started to lean on naturopathy. Once such boon is the naturally available plant source is Neutraceuticals. With its vast natural production and powerful curing ability, the cure to diabetes is a positive sign for maintaining their health status.

Neutraceuticals are foods with specific health benefits used as the dietary supplements and/or nutritional ingredients. It also promotes the optimal health and wellbeing of the diabetic individual. The Lexicon defines a neutraceutical as “any food or food ingredient which is considered to have a beneficial effect on health”. The expression denotes any food product or supplement that may have a beneficial function or physiological effect on the body, the word neutraceuticals, emerging from two recognizable terms s-nutrition and pharmaceuticals.

Neutraceuticals are considered as the part of nutritionally enriched ingredients used to fortify food formulas in a planned and specified manner to achieve the effective health benefits. They are usually natural, bioactive chemical compounds that have health promoting and disease-preventing medicinal properties.

New discoveries are made affirming the health benefits of food ingredients beyond their primary and long established nutritional roles and worldwide health concerns become more serious, growth for nutraceutical based products will likely accelerate. The fastest growing nutraceutical category in the US is sterols which are projected to grow at about 15 per cent annually for the rest of this decade sterol suppliers have recently been given the green light to tout their products cholesterol lowering properties. Since sterols chemical structure is similar to cholesterol, they reduce blood cholesterol by interfering with the body's ability to absorb cholesterol during digestion.

The venue selected for the conduct of study were S.R.C. Diabetic research centre, Baby Hospital, Kovai Medical Centre Hospital and Maruthi Medical Centre and Hospital at Erode city of Periyar District in Tamil Nadu, from where adequate number of diabetic subjects were available.

The investigator gathered the required details from one thousand five hundred subjects (780 men and 720 women) having diabetic disorders. For all the 1500 diabetic subjects, details regarding background information like age, sex, educational status, physical activity pattern, type of monthly family income level, medical history like personal and family history of diabetes, types of treatment, complications and life style pattern and nutritional status like anthropometric assessment, dietary and food consumption pattern, etc.

For all the diabetic subjects, data regarding the blood glucose level for fasting, post prandial and glycosylated haemoglobin levels, were recorded from the sources. Among the 1500 subjects, subsamples (N-275) were selected for the supplementation studies using the following criteria.

1. Age group between 41-50 years
2. Fasting Blood Glucose (FBG) between 150-175 mg / dl.
3. Post Prandial Blood Glucose (PPBG) between 250-275 mg/dl.

4. Serum Total Cholesterol Level ranged between 225-275 mg/dl.
5. Selected subjects were free from other complications and using oral hypoglycemic agent alone were selected for the study.

For supplementation study, 250 diabetic subjects as experimental group were selected and were divided into 10 groups and each group consists of 25 subjects. Each of the experimental group received a specific supplement for the period of 90 days and their effect on blood glucose and lipid profile were recorded before and after the supplementation period and details regarding the supplements are given below:

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| 1. Onion (Big) (50 g) | 6. Soyabeans (25 g) |
| 2. Cinnamon (3 g) | 7. Bay leaves (0.5 g) |
| 3. Cumin seed (5 g) | 8. Flaxseed (5 g) |
| 4. Aritichoke (6 g) | 9. Stevia leaves (1.25 g) |
| 5. Amla (30 g) | 10. Jambolin seed (5 g) |

The results pertaining to the study are summarized as follows.

1. Among the 1500 diabetic subjects participated in the study, 780 were men and 720 were women and their age ranged from 40 to 65 years. More than one third of both men and women subjects were in the age group of 41-45 years.
2. Ninety four per cent of the male diabetic subjects and 92 per cent of the female diabetic subjects were educated.
3. The per cent of male and female doing sedentary activity increased with age, while the per cent of males and females doing moderate and heavy activity decreased with age, in both the sexes.

4. About 46.9 per cent of the selected subjects belonged to nuclear family and 53.1 per cent were in joint family system.
5. Income was not an important factor for the occurrence of diabetic disorders, as the diabetes mellitus is very common in all categories of income levels.
6. Results regarding the age of onset of diabetes revealed that 58.9 per cent of the subjects had it during the age between 35-45 years and 16.8 per cent had its precipitation between 56-65 years of age.
7. Regarding the duration of diabetes, majority (79.2 per cent) was having the diabetes for more than five years and three per cent were having same for less than 10 years.
8. Most of the patients severely experienced the symptoms viz. polyuria (15.9 per cent), polydipsia (19.4 per cent), weight loss (10.8 per cent), hyperglycemia (19.8 per cent), delayed wound healing (14.7 per cent) and glycosuria (8.8 per cent) at the time of investigation. At present the severity of the symptoms has reduced because of constant treatment taken by the diabetic subjects.
9. Tracing the family history of the diabetic subjects, 71 per cent of the subjects had the family history of diabetes mellitus in which 28.8 per cent mothers of the subjects had diabetes and 29 per cent did not have the family history of diabetes mellitus.
10. Regarding the type of treatment majority 86 per cent of the subjects followed the allopathy treatment and 6.7 per cent followed the naturopathy treatment before the study period. During the study period, about 99 per cent of the subjects were undergoing only allopathy

treatment compared to other types of treatment available to maintain their health status.

11. Seventy two per cent of diabetic subjects (63 per cent males and 37 per cent females) were strictly adopted regular exercise either in the early morning or in the evening for one to two hours
12. Results about the complications of the diabetic subjects at the time of investigation are mainly hyperglycemia (77 per cent) and hypertension (22.7 per cent). It was heart warming to note that majority of them were free from severe complications like hypo/hyper glycemia atherosclerosis, etc. But after the onset of disease, most of the subjects suffered from hypoglycemia, hypertension and diabetic foot syndrome etc.
13. Among the selected male diabetic subjects, 41.6 per cent had the habit of drinking alcohol before the diagnosis of disease and only minimum per cent persuade the habit even after diagnosis.
14. Among the diabetic subjects, 66.8 per cent were having the habit of smoking before the incidence of disease and only 39.7 per cent were smoking after the diagnosis.
15. Majority of the selected diabetic subjects (97.2 per cent) consumed beverages before the incidence of diabetes and 46.7 per cent were consuming beverages, after the diagnosis of diabetes.
16. Results of mean height of the selected subjects revealed that majority (49.4 per cent) of the males were in the height range of 161-171cms and 50.7 per cent of the females were in the height range of 141-150cm.
17. Nearly 42 per cent of males were in the weight of 81 and above (kg) and 34.9 per cent of females were in the weight range of 51-60 kg.

18. Grade-I obesity was noticed among 15.6 per cent of the male subjects and 17.2 per cent of the female subjects and 27.2 per cent of male diabetics and 31.6 per cent of female diabetics are at risk of developing obesity. Grade-II was noticed among 30.0 per cent of male diabetic subjects and 27.8 per cent female diabetic subjects.
19. Among one thousand five hundred diabetic subjects, 42.7 per cent of male diabetic subjects and 35.3 per cent of female subjects were having normal waist hip ratio <0.95 and <0.8 respectively and 57.3 per cent of males and 64.7 per cent of females were having abdominal adiposity >0.95 and >0.8 respectively.
20. Among the 1500 diabetic subjects, 29.6 per cent were vegetarians, 59.8 per cent of the subjects were non vegetarians and 10.6 were ova-vegetarians.
21. The food intake of the diabetic subjects (males and female) was deficient when compared with RDA with respect to cereals, leafy vegetables, other vegetables, roots and tubers, fruits, sugar and fats. Further it was noticed that intake of pulses in both males and females and intake of fats in females were found to be excess when compared with the RDA. .
22. Mean nutrient intake of male subjects was deficient when compared with RDA with respect to energy, fat, calcium, thiamin, riboflavin and niacin. But it was noticed that intake of nutrients like protein, iron, retinol and vitamin C was adequate among males compared with the RDA.
23. Mean nutrient intake of female subjects was deficient when compared with RDA with respect to energy, protein, fat, carbohydrate, iron, retinal, thiamin, riboflavin and vitamin C. But intake of nutrients like calcium and niacin were found to be adequate when compared to RDA.

24. The quantity of oils and fats used by the diabetic subjects after the incidence of diabetes was reduced comparatively and the diabetic subjects had started using polyunsaturated fatty acid containing oils instead of saturated fats, and it might be due to dietary counseling.
25. About the consumption of prepared foods, baked foods, fried foods, pickles and fried foods were part of daily diet for the diabetic subjects before the incidence of diabetes. After the incidence of diabetes, the consumption of these items was less in quantity.
26. Among the 1500 diabetic subjects 32.7 per cent consumed the fibre between 5-10g/day, 30.7 per cent were consumed between 16-20g/day and only 11.3 per cent were consumed between 21-25g of fibre in their diet.
27. Percentage of mean overall acceptability scores of the neutraceutical incorporated products such as onion juice, cinnamon bread, cumin seed masala chapatti, artichoke biscuit, okara sevai, bay leaves chapatti, flaxseed bread, stevia leaves tea and jambolin seed dosa shows that all received the scores more than 80 per cent and all the developed products are highly acceptable compared to the standard products.
28. Among the selected one thousand five hundred diabetic subjects, the mean fasting, post prandial blood glucose and glycosylated haemoglobin levels of the subjects were comparatively high when compared to the desirable level.
29. Regarding the results of mean lipid profile values, the mean values of total cholesterol, low density lipoprotein cholesterol, very low density lipoprotein cholesterol and triglycerides of the diabetic subjects were comparatively higher and High density lipoprotein cholesterol is lower

than the standard values for the above said lipid fractions suggested by NCEP (2001).

30. Supplementation of onion extract for the diabetic subjects brought about a significant decrease in blood glucose level (fasting and post prandial) and glycosylated haemoglobin and also decreases in serum total cholesterol, LDL cholesterol, VLDL cholesterol and triglyceride levels but HDL levels increased from 38.22 to 48.61 mg/dl after onion supplementation.
31. Supplementation of cinnamon powder for diabetic subjects, resulted in a notable decrease in fasting, post prandial blood glucose level and also shown a notable decrease in all the cholesterol fractions and triglyceride level and a notable increase in HDL-cholesterol level.
32. Supplementation with cumin seed powder resulted in a marked decrease in fasting blood glucose, post prandial blood glucose and glycosylated hemoglobin and also a marked decrease in total cholesterol, triglyceride, LDL-cholesterol and VLDL-cholesterol and a marked increase in HDL-cholesterol level from 36.09mg/dl to 40.18mg/dl.
33. Supplementation with artichoke powder brought about a striking decrease in blood glucose (fasting and post prandial) and glycosylated hemoglobin level and a notable decrease in total cholesterol, triglyceride, LDL and VLDL- cholesterol and a significant increase of about 2.4mg/dl from initial value was seen in HDL-cholesterol level.
34. The results of the supplementation of amla indicated a decrease in fasting blood glucose, post prandial blood glyucose and glycosylated hemoglobin and also an effective reduction in total cholesterol, triglycerides, LDL cholesterol levels and a significant increase from 34.75mg/dl to 44.75mg/dl was seen in HDL cholesterol levels.

35. Supplementation with soyabean in the form of okara powder helps to decrease the fasting, post prandial blood glucose and glycosylated hemoglobin and also good reduction in total cholesterol, LDL, VLDL cholesterol and triglycerides but marked increase in HDL-cholesterol level.
36. Supplementation with bay leaves lowered the fasting, post prandial blood glucose, HbA1c and a notable decrease in total cholesterol, triglyceride, LDL-cholesterol and VLDL-cholesterol and a marked increase in HDL-cholesterol level.
37. Supplementation of flaxseed powder for the diabetic subjects brought a notable decrease in blood glucose levels (fasting and post prandial) and glycosylated hemoglobin and a significant reduction in serum total cholesterol, LDL, VLDL and triglycerides and marked increase in HDL-cholesterol levels from 37.44mg/dl to 42.35mg/dl.
38. Supplementation with stevia leaves powder supported to lower the blood glucose both fasting and post prandial and glycosylated hemoglobin levels and a notable decrease in various cholesterol fractions and triglycerides and increased HDL-cholesterol level from 36.57mg/dl to 44.95mg/dl among the selected diabetic subjects.
39. The results of the supplementation of jambolin seed powder indicated a recordable decrease in fasting, post prandial blood glucose level and glycosylated hemoglobin level. Results of lipids showed a marked decrease in serum total cholesterol, LDL, VLDL and triglycerides but a notable significant increase in HDL-cholesterol level.

Thus all the nutraceutical supplements like onion, cinnamon, cumin seed, artichoke, okara, amla, bay leaves, flaxseed, stevia leaves and jambolin seed were useful and effective in lowering blood glucose, glycosylated hemoglobin, profile

of lipids and its fractions and increasing high density lipoprotein cholesterol among the selected subjects. Any of the above specific nutraceutical components may be used effectively depending on the blood glucose and the different lipid levels..

To conclude, diabetes disorder apart from adding to the human death toll, bears down heavily on the social and economic conditions of the society. Prevention is possible with the incorporation of suitable hypoglycemic nutraceutical components. So let us hope that nutraceutical supplements will bring desirable changes so that the last minute agony could be prevented.

RECOMMENDATIONS

1. Further studies consisting of large samples and different nutraceutical supplements maybe attempted to confirm the findings of the present study.
2. National level organizations concerned with diet and health must stress on maintaining appropriate body weight for a given height for men and women at all ages, with special attention on people above the age of 50, on war footing.
3. Stress on restriction of fats and oils, sugar and jaggery which increases the risk of obesity and promotion of high fibre foods, fish/fish oil, fresh fruits and green leafy vegetables must start right from the paediatric age.
4. Adequate propaganda should be generated to avoid sedentary lifestyle habits and educating the importance of regular exercise to the public for the in the prevention of diabetes.
5. Altered life style in terms of dietary habits, especially eating fast foods and junk foods, and consumption of lower calorie foods should be practiced to minimize the prevalence of diabetes.
6. Nutrition education and dietary counseling must form an important part of the management of diabetes mellitus.