IJFANS

International Journal of Food And Nutritional Sciences

Volume 3, Issue 1, Jan-Mar-2014, www.ijfans.com e-ISSN: 2320-7876

Official Journal of IIFANS

INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

e-ISSN 2320 –7876 *www.ijfans.com*
Vol.3, Iss.1, Jan-Mar 2014

Research Paper *Open Access*

EFFECT OF SOYBEAN SUPPLEMENTATION ON DYSLIPIDEMIC DIABETICS

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ABSTRACT

Diabetes Mellitus is a disorder of metabolism. In spite of active research, there is currently no proven means of preventing type 1 diabetes. However, changes in lifestyle minimize the risk of type 2 diabetes. The phytochemicals present in soybean have enormous medicinal properties and can cure and combat numerous diseases. Its fibre lowers cholesterol, aid laxation and reduces blood glucose levels. The present study was undertaken with an objective to find out the effect of supplementation of soy foods in selected diabetics with dyslipidemia. Out of the 600 diabetic subjects selected from Erode district, 25 subjects who had abnormal lipid profile were selected based on their willingness and cooperation, to study the effect of supplementation of soybeans. Ten different soy incorporated breakfast dishes and snacks were formulated and organoleptically evaluated. The selected 25 dyslipidemic diabetics were counselled specially on diabetes, foods with low glycemic index, glycemic control, dyslipidemia and maintenance of lipid parameters. The subjects were supplemented with 25g of soybean in the form of *sundal* for a period of 90 days. Results obtained at the end of the study showed that the serum total cholesterol, LDL cholesterol, and triglycerides of the selected dyslipidemic diabetics reduced significantly from the initial levels. The serum VLDL cholesterol did not record any notable reduction. Simultaneously the serum HDL cholesterol was found to increase significantly.

Key Words: Diabetes mellitus, Dyslipidemia, Soybean, Phytochemicals, Glycemic Index.

INTRODUCTION

During the past three decades there has been a sudden and a sharp rise in the prevalence of many disease conditions. This includes heart diseases, kidney diseases, diabetes and its complications and even some cancers which particularly affected urban population in developing countries and India is one of the worst affected countries. This rise can only be attributed to a common environmental or nutritional factor (Diabetic Association of India, 1999).

Diabetes Mellitus is a disorder of metabolism. Diabetes is actually not a single condition but a group of diseases with one thing in common –a problem with insulin. Individuals whose fasting blood glucose is above normal (≥110 mg/dl) but not high enough for diagnosis of diabetes (<126 mg/dl), fall into the Impaired Glucose Tolerance (IGT) classification also referred to as prediabetes. IGT is a risk factor for developing type-2-diabetes. Individuals with IGT often have a complicated assortment of underlying conditions (eg. hypercholestrolemia, obesity or hypertension) that build on one another to create the condition known as syndrome x, or metabolic syndrome, which is a significant risk factor for CVD (Williams, 2005).

In spite of active research, there is currently no proven means of preventing type 1 diabetes. However, changes in lifestyle minimize the risk of type 2 diabetes (Sandiego, 2002). The Glycemic Load of the diet dramatically affects the risk for developing type 2 diabetes. High-GL meals stimulate more insulin secretion than low-GL meals. Post-prandial hyperglycaemia is greater following high-GL diets. The long term consumption of such diets produces chronic hyperglycaemia and insulin resistance, leading to hyperinsulinemia and the eventual damage to the β- cells function in the pancreas leading to type 2 diabetes.

Adequate amounts of whole grain in the diet have shown to reduce the risk of developing type 2 diabetes. Many whole grains have high GL but do provide a good source of fibre (unlike refined carbohydrates), which can help modulate the insulin response. The risk of developing type 2 diabetes may be reduced from eating a diet rich in whole grains, which favourably mediates insulin levels. This has been shown to be especially important for offspring of

people with diabetes. Diets consisting primarily of fruits and vegetables have lower GL than whole grains (Bell and Sears, 2003).

Phytochemicals present in soybean namely genistein and diadzen have enormous medicinal properties that can cure and combat numerous diseases in human body. Its fibre lowers cholesterol, aid laxation and reduces blood glucose levels (Bhuvaneswari and Chithra, 2004). Vitamins, minerals and phytochemical compounds in soy work together to prevent the occurrence of hyper cholesterolemia, breast cancer, colon cancer, kidney diseases, heart diseases, osteoporosis and diabetes.

Considering the above facts, this study was undertaken with an objective to find out the effect of supplementation of soy foods in selected diabetics with dyslipidemia.

MATERIALS AND METHODS

The study was conducted in Erode town of Erode District in Tamilnadu State. Six hundred type 2 diabetics with fasting blood glucose levels more than 120 mg/dL were selected from the Kovai Medical Centre and Hospital (KMCH), Maruthi Medical Centre and Hospital (MMCH) and Priya Diabetic Centre, located in Erode. Their socio economic and nutritional statuses were assessed using a specially designed interview schedule. Out of the 600 diabetic subjects, 25 subjects who had abnormal lipid profile were selected based on their willingness and cooperation, to study the effect of supplementation of soy foods. Nutrient intake by the selected dyslipidemics was also studied. The serum lipid profiles of the 25 diabetic subjects with dyslipidemia were assessed before the supplementation period using Chod-pap method.

SELECTION OF A SUITABLE SOY FOOD WITH LOW GLYCEMIC INDEX (GI)

Ten different soy incorporated breakfast dishes and snacks like *idly*, soy tomato *dosa*, *adai*, soy flakes *uppma*, *chapathi*, soy *sundal*, soy vegetable omelette, *vadai*, and chilly soy chunks and biscuit were formulated, organoleptically evaluated and their nutritive value were calculated. Their GI was also estimated using the standard formula given by Jannie Brand Miller, 2004.

$$GI = \frac{\text{Incremental area under the 2 hour blood glucose curve after taking 50 g of carbohydrate from test food}}{\text{Incremental area under the 2 hours blood glucose curve after taking 50 g of reference food (glucose in water)}} \times 100$$

The mean GI values obtained for the formulated soy foods are presented in Table-1.

Table 1- Mean Glycemic Index of the formulated Soy foods

Name of the soy food	Glycemic Index (GI) Mean ±S D	Category of GI
Soy Sundal	40.06 ± 2.90	Low
Soy Flakes Uppma	45.88 ± 13.87	Low
Soy Vegetable Omelette	52.79 ± 4.85	Low
Soy Tomato Dosa	56.89 ± 11.60	Medium
Soy Adai	56.47 ± 11.26	Medium
Soy Idly	58.52 ± 17.28	Medium
Soy Chapathi	58.81 ± 17.03	Medium
Chilly Soy Chunks	60.20 ± 12.24	Medium
Soy Vadai	65.17 ± 6.00	Medium
Soy Biscuit	66.12 ± 19.61	Medium

Among the formulated soy foods, soy sundal, soy flakes uppma and soy vegetable omelette are most preferred items from the point of low GI. The other recipes were mediocre in their GI values. These are valuable observations for choosing the right recipe with low GI for further studies in this line. Soybean *sundal* had the minimum mean GI value (40.06 ± 2.9) followed by soy flakes *uppma* (45.88 ± 13.87) and Soy Vegetable *Omelette* (52.79 ± 4.85) and they come under the class of low GI foods (GI ≤ 55). All the other foods were found to have medium GI (56-69) (Netzer, 2000). Choosing lower GI foods will probably influence glucose levels similarly to the impact of increasing fiber intake (Carter, 2003). Out of the 10 soy foods studied for GI, whole soybean *sundal* was chosen for supplementation as it recorded a low GI of 40.

COUNSELLING THE SELECTED DIABETICS

The selected 25 dyslipidemic diabetics were counselled specially on diabetes, foods with low GI, glycemic control, dyslipidemia and maintenance of lipid parameters. The importance of soybean in the diet of diabetics was also emphasised and they were motivated to consume the same in their daily diet. They were also taught and strictly instructed to consume only foods without cholesterol and with low GI, and maintain their blood sugar levels within normal range. No drugs were taken by them for correcting dyslipidemia during the study period.

SUPPLEMENTATION OF THE SELECTED SOY FOOD TO THE DYSLIPIDEMIC DIABETICS

Ninety polythene packets containing 25g of soybean each were given to each of the 25 selected subjects in the beginning of the study period. They were asked to prepare it in the form of *sunda*l and consume daily for a period of 90 days. The cooked weight of the *sundal* was 50 g. Special instruction was given not to use coconut in the preparation and to use only two grams of sunflower oil/ gingelly oil for seasoning.

ASSESSMENT OF FINAL LIPID PROFILE OF THE DIABETICS

At the end of the supplementation period, serum lipid profile was again estimated using the same techniques used initially. From the initial and final values the effect of supplementation was assessed.

RESULTS AND DISCUSSION

BACKGROUND INFORMATION ABOUT THE SELECTED DYSLIPIDEMIC DIABETICS

Among the 25 dyslipidemic diabetics selected, 17 were in the age group of 40-50 years and eight were between 50 and 60 years. Nineteen subjects were males and six were females. All the 25 subjects were found to have family history of diabetes mellitus, and seven had family history of heart disease too. It is obvious that genetic factor is the predominant non modifiable etiological factor in precipitating diabetes and cardiovascular diseases. These observations are definite, enlightening and path breaking scientific facts needing publicity to create awareness among the public to be watchful of their health. The mean anthropometric parameters of the selected dyslipidemic diabetics are presented in Table 2.

Table-2 Mean height, weight, BMI and WHR of the selected subjects (N = 25)

Parameters	Mean ± standard deviation		Standard values (Welborn *et al.*, 2003)	
	Men (n = 19)	**Women** (n = 6)	**Men**	**Women**
Height (cm)	166.0 ± 8.08	156.33 ± 3.66	165	158
Weight (kg)	70.0 ± 6.43	63.83 ± 5.56	65	55
Body Mass Index (BMI)	26.28 ± 2.4	26.14 ± 1.60	20	20
Waist Hip Ratio (WHR)	1.02 ± 0.05	0.94 ± 0.01	0.9	0.85

When compared to the standard values given by Welborn *et al.* (2003), the selected subjects were found to be overweight with high Body Mass Index and Waist Hip Ratio. This is one of the reasons for diabetes revealing adequately the need to be cautious on body weight, BMI and WHR which are controllable unlike genetic factors. The mean nutrient intake by the selected dyslipidemic diabetics before and after diet counselling and supplementation are given in Table 3.

Table-3 Mean nutrient intake by the selected dyslipidemic diabetics before and after diet counselling and supplementation

Sex		Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Fibre (g)
Male n=19	RDA	2425	60	500	20	25
	Before	2870.37 ±128.31	54.67 ±5.03	559.3 ±18.13	45.29 ±2.87	19.13 ±1.76
	After	2486.26 ±147.57	65.21 ±3.02	490.8 ±21.27	28.71 ±1.50	28.27 ±1.79
	't' Value	13.46 **	-7.97 **	12.80 **	34.09 **	-17.84 **
Female n=6	RDA	1875	50	375	20	25
	Before	2272.67 ±165.70	45.88 ±3.045	430.5 ±20.50	40.12 ±2.98	17.62 ±1.53
	After	1824.50 ±41.23	58.52 ±2.70	330.50 ±9.73	29.31 ±2.27	27.12 ±5.90
	't' Value	7.06 **	-8.67 **	6.86 **	23.17 **	-4.29 **

** Significant at 1% level. RDA- Recommended Dietary Allowance, Gopalan *et al* (ICMR, 2004)

Initially the mean energy and fat intake of the diabetics were found to be very much higher than the ICMR RDA (Gopalan *et al*., 2004), whereas the mean protein and fibre intakes were lower. But after the counselling session, all the subjects followed strict dietary pattern and the mean nutrient intake was comparable with the RDA. Statistical analysis revealed remarkable reduction in the intake of energy, carbohydrate and fats and increase in the intake of protein and fibre showing the effectiveness of counselling and supplementation of the soybean. They also were regular in doing their routine physical exercise/walking during the study period. According to Kurpad (2007), positive energy balance results in obesity, and dietary and physical activity patterns are the determining factors for the development of positive energy balance.

EFFECT OF SUPPLEMENTATION OF SOYBEAN ON THE LIPID PROFILE OF THE SELECTED DIABETICS

Mean serum levels of total cholesterol, HDL cholesterol, LDL cholesterol, VLDL cholesterol and triglycerides of the selected diabetics with dyslipidemia, before and after supplementation period are presented in Table- 4.

Table-4 Mean initial and final lipid profile of the selected dyslipidemic diabetics (N = 25)

Parameters	Normal Value (mg /dL)	Mean ± standard deviation			't' value
		Initial (mg /dL)	Final (mg /dL)	Difference (mg/dL)	
Total cholesterol	< 200	213.16 ± 55.21	205.88 ± 49.65	7.28	3.75**
HDL cholesterol	> 40	38.76 ± 12.84	41.4 ± 11.85	2.64	4.6**
LDL cholesterol	60 -130	138.32 ± 54.59	128.88 ± 49.48	9.44	3.6**
VLDL cholesterol	2 - 38	36 ± 11.01	35.6 ± 10.59	0.4	0.6NS
Triglycerides	10 -150	163.28 ± 48.14	154.4 ± 47.14	8.88	3.3**

Note: t = 2.2797, NS = Not significant, ** = Significant at 1% level.

It is evident that the serum total cholesterol, LDL cholesterol, and triglycerides of the selected dyslipidemic diabetics reduced significantly from the initial levels. The serum VLDL cholesterol did not record any notable reduction. Simultaneously the serum HDL cholesterol was found to increase significantly to 41.4 mg/dL registering a positive impact of the consumption of whole soybean with proper dietary pattern and physical exercise.

Results of this study are in accordance with those of Reddy (2006) and Messina (2004), who reported that soy protein directly lowered serum total cholesterol levels. The hypocholesterolemic effect of soy protein was officially recognized in October 1999 with an authorization by the US Food and Drug Administration. Seshadri (2009) reported that the soy isoflavone genistein improved natural insulin secretion and also helped in reducing abdominal fat. A study by Lin *et.al*. (2003) revealed that soy protein diet significantly lowered the plasma total cholesterol concentration by nine per cent.

CONCLUSION

As a result of supplementation of soybean and diet counselling to selected dyslipidemic diabetics, remarkable reduction in the intake of energy, carbohydrate and fats and increase in the intake of protein and fibre were observed. The subjects were also regular in doing their routine physical exercise/walking during the study period.

The dyslipidemics also recorded significant reductions in total cholesterol (213.16 to 205.88 mg/dL), LDL cholesterol (138.32 to 128.88 mg/dL) and triglycerides (163.28 to 154.4 mg/dL) after taking the whole soybean supplementation for a period of 90 days. The HDL cholesterol also showed a noticeable increased from 38.76 to 41.4 mg/dL thus confirming the positive impact of soybean supplementation accompanied by physical activity and dietary management. Thus consumption of soy-containing foods may prevent or slow-down the development of cardiovascular disease in type 2 diabetics.

ACKNOWLEDGEMENT

The author profoundly thanks **Dr.R.Chithra**, Associate Professor in Nutrition and Dietetics, PSG College of Arts and Science, Coimbatore, for her valuable guidance and support in completing this paper successfully.

REFERENCES

- Diabetic Association of India .Guidelines for prevention and management of diabetes and its complications. JDAI.1999; 39(3):52.
- Williams, S.R. Basic nutrition and diet therapy. Stalinic Elsevier Publication. 2005; P 371.
- Sandiego. Encyclopaedia of Foods: A guide to healthy nutrition, Academic Press, California. 2002; P 57-60.
- Bell, S.J. and Sears, B. Low GL Diets: Impact on Obesity and chronic diseases. Critical reviews in Food Science and Nutrition. 2003; 43(4):357-377.
- Bhuvaneswari, P. and Chithra, R. Role of soy and linseed on glycemic response in selected diabetics. Journal of Food, Nutrition and Dietetics. 2004; 2(1): 12.
- Jennie Brand Miller. Effect of GI on food. 2004; in: glycemicindex.com.
- Netzer, C.T. The complete book of food counts, 5th edn Dell publishers. 2000; P 42-52.
- Carter, S. Making Sense of the Glycemic Index. Nutrition Research News. 2003; P-7.

- Welborn, T.A., Dhaliwal, S.S. and Bennett, S.A. Waist-Hip Ratio is the dominant risk factor predicting cardiovascular death in Australia. Medical journal of Australia.2003; 179(11):580-585.
- Gopalan, C., Ramasastri, B.V. and Balasubramanian, S.C. Nutritive value of Indian foods, National Institute of Nutrition, Hyderabad. 2004; P 10, 47-91.
- Kurpad, A.V. A Pathophysiology construct for obesity. Souvenir of National Conference on Facts and Myths of Obesity, conducted at PSG College of Arts and Science, Coimbatore. 2007; P 28.
- Reddy, Y.S. Food processing and bioactive compounds, Gene-tech Books Publishers, New Delhi. 2006; P 5, 28.
- Messina, M. Soy and health. Herald of Health, Sep.2004; P 6.
- Seshadri, H. Supplement those drugs. The Hindu Magazine, June 7, 2009; P 6.
- Lin, M., Superko, R., Williams, P., Limp, P.J. and Charles, M.A. Diabetes and lipid abnormalities. Diabetes Nutrition Metabolism Abnormalities. 2003; 16(1):56-64.