

Efficacy of Nutraceuticals in Ameliorating the Risk of Coronary Heart Disease

Inderjit Singh, Parneet Baring, Rita Jain and Kiran Grover*

Department of Food and Nutrition, College of Home Science, Punjab Agricultural University, Ludhiana, Punjab, India

KEYWORDS Anthropometry. Blood and Lipid Profile. Nutraceuticals. Nutrition Intervention. Nutrition Education

ABSTRACT Thirty five postmenopausal subjects who were at risk of coronary heart disease were selected. Background information, blood and lipid profile analysis, blood pressure, anthropometric measurements and dietary pattern of subjects was recorded. Nutrition knowledge was also assessed by applying KAP test. In addition to their normal diet, the subjects were advised to include nutraceuticals for a period of 4 months. They were also imparted nutrition education during the period. The consumption of whole grain cereals and pulses, fruits, vegetables, skim milk products increased significantly whereas a significant reduction in consumption of sugar, bakery, meat and meat products, fried food was observed. The subjects started consuming restricted amount of a combination of *desi ghee*, mustard oil and soyabean oil which significantly improved the n-6/ n-3 ratio. The inclusion of nutraceuticals resulting in a significant reduction in weight, BMI, fat mass, MUAC, TSFT, systolic and diastolic blood pressure, blood glucose, total cholesterol, LDL-C, VLDL-C, total cholesterol: HDL-C, LDL-C: HDL-C and total triglycerides was observed. Thus, the addition of nutraceuticals like soyabean as soya milk and soya granules, wheat bran and oats coupled with nutrition education had a significant effect on the blood and lipid profile of the subjects.

INTRODUCTION

Coronary heart disease (CHD) is emerging as the major scourge of mankind, even though many developments in the diagnosis, management and prevention of risk factors have taken place. Its risk factors are of significant magnitude in the population of India to be a major health problem (Singh et al., 1995). CHD is more common in middle and high socio-economic status which may be due to greater consumption of dietary fat and a more sedentary life style. A positive impact of dietary counselling with changes in life style, dietary pattern, intake of food and nutrients, anthropometry and lipid profile has been reported (Sandhu and Singh, 2001). The role of fibre in lowering risk of CHD emphasized the importance of food based strategies for maintaining health. Since fibre serves as a marker for diets rich in plant foods, so these have a potential for disease risk reduction. Therefore, the present study was an attempt to examine the efficacy of nutraceuticals coupled with nutrition counselling on the health of the subjects in reducing the risk factors associated with CHD.

MATERIALS AND METHODS

Thirty-five post menopausal women in the age group of 45 to 54 years belonging to the

professional class and who were at risk of coronary heart disease were selected for the study. A well constructed, pre-tested questionnaire was used for collecting the information on various aspects of data collection. The efficacy of nutraceuticals and impact of nutrition education was studied on the blood and lipid profile, anthropometry, clinical profile and dietary intake of the subjects for a period of 4 months. The study was carried out in three phases.

Phase I: Information on general, occupation, life style aspects, medical history and food intake of all the subjects were recorded. Estimation of blood and lipid profile was done, anthropometric measurement were recorded. Pre-nutrition knowledge was conducted.

Phase II: The based on nutrition knowledge test scores. Nutrition education was imparted diet of all 35 subjects was supplemented by using nutraceuticals (wheat bran 30g/d, cooked oats 100g/d, soya milk 150 ml/d and soya granules 50g/d) for a period of four months. A month's break was given to each subject before starting the next phase.

Phase III: Life style related information and food intake was recorded by using the same interview schedule, anthropometric measurements were recorded, blood and lipid profile was estimated and post-nutrition knowledge test was conducted.

Gain in scores and quantum of improvement

was assessed. The data was statistically analysed by using a computer programme.

RESULTS AND DISCUSSION

The general information of the subjects revealed that 74.28 per cent of the subjects who were at risk of coronary heart disease were between 50-55 years, the fifth decade of life is considered as the prime period of developing the risk for CHD. Similar findings were reported by Sandhu and Singh (2001). Hypercholesterolemia (34.37%), hypertension (32.29%) and overweight (33.33%) were the most commonly reported risk factors in the subjects. Ninety four per cent of the subjects were taking medicines. As regards the family liabilities, it was reported that all the subjects had one or more liabilities to take care of like, marriage of their children being the major liability (35%) followed by 30 per cent of the subjects having health problems and 16.25 per cent of the subjects had to pay the house loan.

Nutrition education resulted in significant improvement in the life style of the subjects. Seventy per cent of the subjects developed a regular habit of walk, 20 per cent of the subjects started doing stretch exercises and 51 per cent subjects started to meditate for mental relaxation. Sleep hours were also improved in most of the subjects.

Significant changes in the dietary pattern of the subjects were also observed (Table 1). The consumption of whole grain cereals and pulses, fruits, vegetables, skim milk products increased significantly whereas a significant reduction in consumption of sugar, bakery, meat and meat

products, fried food was observed. The subjects started consuming restricted amount of a combination of *desi* ghee, mustard oil and soyabean oil which significantly improved the n-6/n-3 ratio. The low intake of n-6 fatty acid and high intake of n-3 fatty acids is reported to be associated with lower risk of heart disease (Siscovick et al., 2000 and Schacky, 2000). The results in the present study are in accordance with the studies of Baring (2000) and Sandhu and Singh (2001).

Table 2 indicated that nutrition intervention with nutraceuticals resulted in significant decrease in the intake of energy, carbohydrates, total fat, PUFA, SFA, cholesterol, n-6/n-3 ratio. Significant increase was observed in case of protein, P:S ratio, dietary fiber and n-3 fatty acid. These changes were due to decreased preference of fried foods, dietary fat, sweets and puddings and increased intake of cardioprotective foods like soyabean, wheat bran and oats. Similar to the present study Clarkson (2002) also reported that the increase in intake of soyabean and pulses could result in 20-30% reduction in heart diseases. There was an increase in percentage contribution of energy from proteins (12.59 to 18.33%) and complex carbohydrates (65.01 to 66.38%) but the contribution of fat from total energy had decreased (22.4 to 15.29%) with a decrease in the contribution of energy from PUFA (3.06 to 2.2%) and SFA (9.5 to 5%). Gopalan and Krishnaswamy (2000), Vindon et al. (2001), Suh et al. (2001) also suggested that in order to lower the LDL-C and improve the HDL-C there is a need to improve percentage of calories from complex CHO along with 10 per cent of calories each from SFA, PUFA and MUFA.

A significant ($p \leq 0.01$) increase in the intake of

Table 1: Daily food intake of the subjects (mean $\pm$ S.E.) N=35

Food groups(g/day)	Beginning of the study	End of the study	Paired t-value	RDA (g) ¹
Cereals	345.23 $\pm$ 52.25	240.00 $\pm$ 20.76	10.302***	350-400
Pulses	70.86 $\pm$ 17.13	125 $\pm$ 15	12.312***	40-50
Roots and tubers	90.85 $\pm$ 26.01	81.0 $\pm$ 20.7	3.30***	70-100
Green leafy vegetables	42.83 $\pm$ 41.95	57.57 $\pm$ 40.28	1.472***	50-100
Other vegetables	286.20 $\pm$ 56.49	301.43 $\pm$ 63.06	5.360***	60-75
Fruits	310.57 $\pm$ 87.55	329.86 $\pm$ 53.16	1.091 ^{NS}	70-100
Milk and milk products	509.6 $\pm$ 110.37	250.0 $\pm$ 50.28	12.351***	200-250
Meat and poultry	38.6 $\pm$ 19.6	28.1 $\pm$ 26.7	1.85 ^{NS}	40-60
Visible ghee	2.17 $\pm$ 3.03	5.00 $\pm$ 0.00	5.516***	-
Visible oil	14.09 $\pm$ 6.97	5.00 $\pm$ 0.00	7.710***	20-40
Sugar	20.51 $\pm$ 7.47	12.14 $\pm$ 3.04	6.739***	20-30
Nuts and oilseeds	7.42 $\pm$ 5.8	4.9 $\pm$ 0.18	2.53**	-

*** Significant at 1% level

** Significant at 5% level

NS non-significant

¹Gopalan et al. (1989)

Table 2: Daily Nutrient intake of the subjects (mean±S.E.) N=35

Nutrients	Beginning of the study	End of the study	Paired t-value	RDA (g) ¹
Energy (Kcal)	2170 ± 230.63	1871 ± 304.66	4.863***	1800-2400 ¹
Protein (g)	69.1 ± 9.52	85.1 ± 4.10	8.445**	50-70 ¹
Carbohydrates (g)	350 ± 39.12	308 ± 15.42	5.370***	300-340 ¹
Total fat (g)	54 ± 9.59	32 ± 2.86	13.612***	40-60 ¹
Polyunsaturated fatty acids (PUFA) (g)	7.40 ± 2.76	4.60 ± 1.03	5.618***	<18.56 ¹
Saturated fatty acids (g)	22.94 ± 4.36	10.40 ± 0.60	16.988***	<20 ¹
P: S ratio	0.325	0.44	-	0.8-1.0 ¹
Cholesterol (mg)	75 ± 2.13	29 ± 2.54	35.56***	300 ¹
Dietary fibre (g)	8.73 ± 0.83	31.04 ± 1.32	48.392***	25g/1000 Kcal ¹
n-6	12.8 ± 1.7	7.9 ± 1.7	11.7***	
n-3	1.44 ± 0.22	1.75 ± 0.203	6.08**	
n-6/n-3	8.88 ± 1.2	4.5 ± 0.95	16.9***	<5

*** Significant at 1% level

** Significant at 5% level

¹ Ghafoorunisa and Krishnaswamy (1998)

ascorbic acid, β -carotene, folic acid, thiamine, riboflavin, niacin was observed (Table 3). Loria et al. (2000) emphasized that Vitamin C play an important role in preventing α CVD by scavenging free radicals. Significant increase in β -carotene was mainly attributed by high intake of mangoes, papaya, yellow pumpkin, cruciferous vegetables. Chandrasekhar et al. (2000) also reported pumpkin to be negatively associated with serum cholesterol level.

Nutraceuticals like soyabean, wheat bran and oat alone provided 1.4 mg of thiamine. 0.6 mg of riboflavin and 7.76 mg of niacin. Similar findings were reported by Baring (2000) and Glew et al. (2001) reported an inverse relationship between

folic acid intake and homocysteine in both men and women subjects with low folate levels had 59 per cent increased risk of death from CHD. Intake of minerals such as magnesium, potassium, phosphorus, iron and zinc increased significantly whereas calcium and sodium intake decreased significantly (Table 3) which may be due to reduced intake of milk and it was further found that subjects also curtailed the consumption of processed and preserved foods and dry fruits.

Nutrition intervention resulted in a significant decrease in the values of total cholesterol, LDL-C, VLDL-C, total cholesterol: HDL-C, LDL-C: HDL-C and total triglycerides from 250 to 209 mg%, 136 to 117 mg%, 69.77 to 38 mg%, 4.64 to 3.89,

Table 3: Daily vitamins and minerals intake of the subjects (Mean±S.E.) N=35

Nutrients	Beginning of the study	End of the study	Paired t-value	RDA (g) ¹
Vitamins				
Ascorbic acid (mg)	139.74 ± 47.25	214.60 ± 107.02	4.014***	40 ²
β -carotene (μ g)	9134.83 ± 5408.98	12319.60 ± 5443.49	2.709***	2400 ²
Thiamine (mg)	1.71 ± 0.23	2.59 ± 0.12	19.862***	0.9 ²
Riboflavin (mg)	1.30 ± 0.23	1.75 ± 0.21	7.898***	1.1 ²
Niacin (mg)	14.63 ± 2.57	18.57 ± 1.27	7.794***	12 ²
Folic acid (μ g)	252.57 ± 76.87	277.40 ± 46.01	1.833*	100 ²
Minerals				
Magnesium (mg)	510.74 ± 207.02	635.26 ± 28.72	3.617***	350 ¹
Potassium (mg)	1532 ± 43.39	1738 ± 684.69	3.9***	-
Calcium (mg)	1098 ± 186.6	765 ± 42.21	9.676***	400 ²
Phosphorus (mg)	1600 ± 204.62	1889 ± 84.96	7.014***	400 ²
Iron (mg)	27.57 ± 10.94	29.91 ± 4.27	0.821 ^{NS}	30 ²
Sodium (mg)	231.74 ± 8.8	190.92 ± 68.2	2.17**	-
Zinc (mg)	3.71 ± 1.27	5.94 ± 1.41	7.072***	15 ¹

*** Significant at 1% level

** Significant at 5% level

* Significant at 10% level

¹ Gopalan et al (1989)² Ghafoorunissa and Krishnaswamy (1998)

2.52 to 2.19 and 283 to 191 mg% respectively (Table 4). Anderson and Anna (1999) observed that soyabeans and soy foods have multifaceted health promoting effects including cholesterol reduction and improved vascular health. Further Potter (1998) reported that consumption of soy protein rather than animal protein significantly decreased serum concentration of triglycerides, total cholesterol and LDL-C. Inclusion of nutraceuticals along with decreased intake of Kcal, fat, cholesterol, and increase intake of fiber and fresh fruits and vegetables further attributed to the decrease in the lipid profile of the subjects. Not only significant changes were observed in the lipid profile of the subjects but also there was a significant decrease in the values of systolic,

diastolic blood pressure and random blood glucose (Table 5). This was due to the intake of nutraceuticals like wheat bran, oats and soyabeans, increase in physical activity and decrease in the intake of salt. Further there was significant reduction in weight, BMI, WHR, TSFT and MUAC (Table 6) as a result of inclusion of nutraceutical foods along with nutrition counselling.

Nutrition knowledge test scores of total, dietary, fat, nutraceuticals, nutrients, life style had significantly increased from 6.4 to 17.6, 1.75 to 6.09, 2.1 to 6.2, 1.0 to 3.7, 4.8 to 8.5 and 1.06 to 3.38 respectively (Table 7). The main reason for these positive changes in the patients of the present study was because they were motivated to

Table 4 : Lipid profile of the subjects (Mean±S.E.) N=35

Parameters	Beginning of the study	End of the study	Paired t-value	Standard
Total cholesterol (mg%)	250.34 ± 69.31	209.86 ± 37.27	6.041***	<200 ¹
LDL-C (mg%)	136.09 ± 65.12	117.77 ± 27.67	2.414**	<130 ¹
VLDL-C (mg%)	69.77 ± 45.22	38.20 ± 6.96	4.151***	<40 ¹
HDL-C (mg%)	53.91 ± 12.92	53.91 ± 15.58	0.230 ^{NS}	>50 ¹
Total cholesterol: HDL-C	4.64	3.89	-	<5
LDL: HDL	2.52	2.19	-	<3
Total triglycerides (mg%)	283.86 ± 93.99	191.09 ± 34.68	7.16***	<150 ¹

** Significant at 5% level

*** Significant at 1% level

NS Non-significant

¹Ghafoorunissa and Krishnaswamy (1998)

Table 5: Blood profile of the subjects (Mean±S.E.) N=35

Parameters	Beginning of the study	End of the study	Paired t-value	Standard ¹
Systolic blood pressure (mmHg)	166.34 ± 18.40	141.86 ± 17.07	9.208***	<140
Diastolic blood pressure (mmHg)	92.57 ± 8.07	85.81 ± 6.41	5.109***	<90
Random blood sugar (mg%)	115.37 ± 12.22	104.71 ± 15.83	3.084***	<140

*** Significant at 1% level

¹ Ghafoorunissa and Krishnaswamy (1998)

Table 6: Anthropometric measurements of the subjects (mean±S.E.) N=35

Parameters	Beginning of the study	End of the study	Paired t-value	Standard
Weight (kg)	67.17 ± 9.13	62.61 ± 6.96	8.515***	50 ⁴
Height (cm)	157.03 ± 6.26	157.03 ± 6.26	-	-
Fat mass (kg)	22.83 ± 8.06	20.71 ± 6.37	4.146**	-
Body mass index (kg/m ²)	27.01 ± 4.41	25.52 ± 3.46	4.394***	18 - 25 ²
Tricep skinfold thickness (mm)	23.77±1.30	21.53 ± 1.13	9.862***	12.5 ³
Mid upper arm circumference (MUAC) (cm)	30.01 ± 1.42	27.49 ± 1.84	9.53***	32.2 ³
Waist to hip ratio	0.84 ± 0.06	0.80 ± 0.05	2.96***	<0.8 ¹

*** Significant at 1% level

¹ Ghafoorunissa and Krishnaswamy (1994)

² Antia and Abraham (1997)

³ NCHS Standards (1985)

⁴ Ghafoorunissa and Krishnaswamy (1998)

Table 7: Nutrition knowledge test scores of the subjects (Mean±S.E.) N=35

Parameters	Pre-test	Post-test	Gain in scores	Paired t-value	Quantum of improvement
Total	6.40 ± 0.5	17.60 ± 0.13	11.20	98.84***	2.75
Dietary	1.75 ± 1.09	6.09 ± 0.10	4.34	29.59***	3.48
Fat	2.10 ± 0.11	6.20 ± 0.03	4.10	108.51***	2.90
Nutraceuticals	1.00 ± 0.6	3.7 ± 0.05	2.70	26.63***	3.70
General nutrients	4.84 ± 1.1	8.55 ± 0.7	3.71	19.34***	1.76
Life style	1.06 ± 0.05	3.38 ± 0.5	2.32	31.57***	3.10

*** Significant at 1% level

understand and accept the changes in their dietary and life style pattern. Similar findings were repeated by Barring (2000) and Sandhu and Singh (2001)

CONCLUSION

It can be concluded that the inclusion of nutraceuticals (cardioprotective foods) like soyabean, wheat bran and oats coupled with nutrition education had a significant effect on the lipid profile of the subjects which was evident from the reduction in total cholesterol, LDL-C, VLDL-C, LDL:HDL-C ratio and increase in HDL-C, TG. Therefore, it is strongly recommended that above mentioned nutraceuticals must be included in the dietaries to reduce the risk factors associated with coronary heart disease.

REFERENCES

- Anderson, J.W. and Anna, T.J.: Whole grains and protection against coronary heart disease. *Am. J. Clin. Nutr.*, **70**: 307-8 (1999).
- Antia, F.P. and Abraham, P.: *Clinical Dietetics and nutrition*. Oxford University Press, Delhi, Pp. 396-415 (1997).
- Barring, P.: *Efficacy of Multiple Dietary Approaches in Reducing Coronary Heart Disease*. M.Sc thesis. PAU, Ludhiana, India (2000).
- Chandrasekhar, V., Koushalya and Eapen, D.: Retention of β -carotene from selected greens and absorption of β -carotene from pumpkin leaves in adults. *Ind. J. Nutr. Diet.*, **37**: 233 (2000).
- Clarkson, T.B.: Soy, soy phytoestrogens and cardiovascular disease. *Am. J. Clin. Nutr.*, **132**: 566S-69S (2002).
- Ghafoorunnisa and Krishnaswamy: Fatty acid composition of food items. In: *Diet and Heart Disease*. National Institute of Nutrition, Hyderabad, Pp. 40-51 (1994).
- Ghafoorunnisa and Krishnaswamy K.: *Diet and heart disease*. NIN, Hyderabad, Pp. 21-62 (1998)
- Gopalan, C. and Krishnaswamy, K.: *Nutrition in Major Metabolic Diseases*. Oxford University Press, New Delhi, p. 119 (2000)
- Gopalan, C., Ramasastri, B.V. and Balasubramanian, S.C.: *Nutritive value of Indian Foods*. 3rd Ed. NIN, Hyderabad (1989)
- Glew, R.H., Williams, M., Conn, C.A., Cadena, S.M., Gassey, M., Okelo, S.N. and Varderjagt, D.J.: Cardiovascular disease risk factors and diet of Fulani pastoralists of northern Nigeria. *Am. J. Clin. Nutr.*, **74**: 730-36 (2001).
- Loria, C.M., Klag, M.J., Caulfield, L.E. and Whelton, P.K.: Vitamin C status and mortality in US adults. *Am. J. Clin. Nutr.*, **72**: 139-45 (2000).
- NCHS: Anthropometric reference data and prevalence of overweight US 1976-80. *Vital and Health Statistics Series* 111: No. 238 (1985).
- Potter, S.M.: Soya protein and cardiovascular disease: The impact of bio active components in soya. *Nutr. Rev.*, **8**: 231-35 (1998)
- Raghuram, T.C., Pasricha, S. and Sharma, R.D.: *Diet and Diabetes*. NIN, Hyderabad (1998).
- Sandhu, N. and Singh, I.: Impact of dietary counselling on anthropometric and clinical profile on male coronary heart disease patients belonging to business community. *J. Res. Punjab agric. Univ.*, **38(3-4)**: 325-32 (2001).
- Schacky, C.V.: n-3 fatty acids and prevention of coronary atherosclerosis. *Am. J. Clin. Nutr.*, (Supple) **224S-27S** (2000).
- Singh, R.B., Ghosh, S., Beegom, R., Agarwal, P., Singh, R., Srivastav, S., Rastogi, S.S., Postgilone, A. and Shoumim, Z.: Epidemiological study of coronary artery disease and its risk factors in an elderly urban population of north India. *J. Am. Coll. Nutr.*, **14(6)**: 628-634 (1995).
- Siscovick, D.S., Raghunathan, T.E., King, J., Weinmann, S., Cobb, L.A., Copas, M.K., Pstay, B.M.: Dietary intake of long chain n-3 polyunsaturated fatty acids and risk of cardiac arrest. *Am. J. Clin. Nutr.*, **71**: 208 S – 12S (2000)
- Suh, I., Oh, K.W., Lee, K.H., Psaty, B.M., Nam, C.M. and Shim, W.H.: Moderate dietary fat consumption as a risk factor for ischemic heart disease in population with low fat intake: case control study in Korean men. *Am. J. Clin. Nutr.*, **73**: 722-27 (2001).
- Vindon, C., Bouchir, P., Cachefo, A., Peroni, O. and Beyfat, M.: Effects of isoenergetic high carbohydrate compared with high fat diets on human cholesterol synthesis and expression of key regulatory genes of cholesterol metabolism. *Am. J. Clin. Nutr.*, **13**: 878 (2001).