International Food Research Journal 19(1): 297-302 (2012)

Effect of dietary fiber on blood lipid profile of selected respondent

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Abstract: Recent nutrition research evidence emphasizes the importance of fiber in health. Fiber includes pectin, gum, mucilage, cellulose, hemicelluloses and lignin. Since there are very few studies on the effect of fibre on serum lipid profile, this study was undertaken to find out fiber intake, serum lipid profile and to study the impact of formulated high fiber supplements on serum lipid profile of selected respondents. A sample of 300 families were selected randomly in Kolhapur city of Maharashtra State (India). Using an interview schedule the socio-economic status, dietary pattern and prevalence of diseases among randomly selected 300 respondents were studied. In order to test the knowledge of the selected sample regarding fiber, formulated questions were raised. A three day weightment method was conducted on sub sample of 50 respondents. The mean daily food intake was calculated. There was no significant change in the HDL Cholesterol value after supplementation. The control group also showed no change. The crude fiber content of the low income group subject doubled from 9 gm to 17.5 gm while in the middle income group subject it increased from 8.4 gm to 14.5 gm. Regarding the serum lipid profile all the selected samples had normal cholesterol level irrespective of their fiber intake but it was higher in the high income group than the other two income groups. With regards to roots and tuber's and other vegetables expect for the high income group in the other income groups, the intake did not meet the recommended allowance.

Keywords:Dietary fiber, cholesterol, LDL-cholesterol and triglycerides

Introduction

Dietary fiber comes from the portion of plants that is not digested by enzymes in the intestinal tract. Part of it, however, may be metabolized by bacteria in the lower gut. Different types of plants vary in their amount and kind of fiber. Bingham and Cummings (1990). Shows that fiber includes pectin, gum, mucilage, cellulose, hemicellulose and lignin. Pectin and gum are water-soluble fibers found inside plant cells. They slow the passage of food through the intestines but do nothing to increase fecal bulk. Insoluble fibers also decrease cholesterol and can help lower blood glucose. Beans, oat bran, fruit and vegetables contain water-soluble fiber. In contrast, fibers in cell walls are water insoluble. These include cellulose, hemicellulose and lignin. Such fibers increase fecal bulk and speed up the passage of food through the digestive tract. Wheat bran and whole grains contain the highest amounts of insoluble fiber, but vegetables and beans also are good sources. Sometimes there is confusion as to the difference between crude fiber and dietary fiber. Both are determined by a laboratory analysis, but crude fiber is only one-seventh to one-half of total dietary fiber (Trowel, 1996).

The current attention being given to the role of dietary fibre in prevention of certain diseases is largely due to the observation that patterns of disease observed in Africa and Asia were different from those in Western countries. It was suggested that the dietary fibre content was associated with this difference. Although it is not yet proven, there is evidence to suggest that a diet high in dietary fibre can be of value for treating or preventing such disorders as constipation, irritable bowel syndrome, diverticular disease, hiatus hernia and haemorrhoids. Some components of dietary fibre may also be of value in reducing the level of cholesterol in blood and thereby decreasing a risk factor for coronary heart disease and the development of gallstones. Dietary fibre is beneficial in the treatment of some diabetics.

The actual role of dietary fibre in many of these disorders is not known. It may be that dietary fibre as such is not the major factor. When high dietary fibre foods are eaten, other foods, which may be responsible for the disease, are either reduced in quantity or completely excluded. For example, diets that are high in fibre tend to be low in energy and these diets can be useful in weight control. People who are grossly overweight (more than 130 per cent of desirable weight or with a body mass index of about 30 kilograms per square meter) are more prone to heart disease and diabetes. The greatest amount of dietary fibre in wheat is in the outer layer or bran, of the wheat grain. When white flour is produced, the bran layer is removed and the dietary-fibre content of the flour is greatly reduced. Flour made from whole

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grains contains about three times as much dietary fibre as white flour. It is probably reasonable to aim for a dietary fibre intake of between 35 and 45 grams per day, compared with current intakes in Western countries of about 20 grams per day.

American Dietetics Association (1981) Shows that low blood cholesterol levels (below 200 mg/dl.) have been associated with a reduced risk of coronary heart disease. The body uses cholesterol in the production of bile acids some of which are excreted daily. The consumption of water-soluble fiber binds to bile acids, suggesting that a high-fiber diet may result in an increased excretion of cholesterol. Some types of fiber, however, appear to have a greater effect than others. The fiber found in rolled oats is more effective in lowering blood cholesterol levels than the fiber found in wheat. Pectin has a similar effect in lowering the amount of cholesterol in the blood. High-fiber diets may be useful for people who wish to lose weight. Fiber itself has no calories, yet provides a "full" feeling because of its water-absorbing ability. For example, an apple that contains fiber is more filling than a half cup of apple juice that contains about the same calories but no fiber. Foods high in fiber often require more chewing, thus it takes more time to eat, so a person is unable to eat a large number of calories in a short amount of time (Drehet, 1997).

Fraser *et al*. (1988) Shows that dietary fiber is found only in plant foods: fruits, vegetables, nuts and grains. Meat, milk and eggs do not contain fiber. The form of food may or may not affect its fiber content. Canned and frozen fruits and vegetables contain just as much fiber as raw ones. The removal of seeds, peels or hulls also reduces fiber content. Whole tomatoes have more fiber than peeled tomatoes, which have more than tomato juice. Likewise, whole wheat bread contains more fiber than white bread. Since there are very few studies on the effect of fibre on serum lipid profile, this study was undertaken to find out fiber intake, serum lipid profile and to study the impact of formulated high fiber supplements on weight and serum lipid profile of selected respondents.

Materials and Methods

A sample of 300 families belonging to the income of low (below Rs. 10,000) middle (Rs. 1000 - 2500) and high, (above Rs. 2500 per month) in Kolhapur city of Maharashtra State (India) were selected at random. Using an interview schedule the socio-economic status, dietary pattern and prevalence of diseases among randomly selected 300 respondents were studied. In order to test the knowledge of the selected sample regarding fibre, formulated questions were raised.

A three day weightment method was conducted on sub sample of 50 respondents. The mean daily food intake was calculated. The mean daily nutrient intake of energy, protein, calcium, iron, thiamine, vitamin 'C and crude fibre values were computed using the Nutritive Value of Indian Foods by ICM R and compared with ICMR recommended daily allowances (Gopalan *et al.*, 1992) in order to find but the relation between the fibre intake and lipid profile, total cholesterol, LDL, VLDL, HDL cholesterol and triglyceride were determined for 50 respondents (Fridwald, 1989). Diseases like hypercholesterolemia, hyper tension and obesity were found only among the high income group in the present study. Hence Ten control group and Ten experimental groups belonging to the high income were selected for the supplementation of high fibre foods. A high fibre supplementation was formulated based on the mean daily fibre intake of the selected sample.

The mean daily crude fibre intake, computed using the Nutritive Value of Indian Foods by ICMR, was five gram in middle income group and eight gram in high income group. In addition to the daily intake, 25 gram high income group respondents respectively were given, to meet the suggested value of 30 gram of crude fibre. Fibre rich foods like whole grams, vegetables and fruits were selected. Two fruits (apple/grapes/dates/sapota/sweet lime) for breakfast and dinner, and carrot and tomato salad along with lunch were given. Pulses like horse gram, peas dry, green gram, cow pea and Bengal gram were supplemented in the form of sundal for tea in the five day's menu. This supplementation was given for a period of 45 days. Diets high in fibre and low in fat lower serum cholesterol and triglycerides and promote weight loss (Heaton, 1993). To see the effect of high fibre foods on weight and serum lipid profile like total cholesterol, triglyceride, LDL, VLDL and HDL cholesterol, ten obese persons who were selected for the study.

Results and Discussions

In the 300 respondents, 30% each were belonging to the low (below Rs 5000/month) and middle income (Rs. 5000-15,000), while 40% were high income group (above Rs. 15,000). With regard to literacy level, out of the 300 respondents in Kolhapur city 121 were literates in study area out of which 75 were males and 46 were females. Among the low income families, labourers on daily wages were dominated in study area and Managers, lecturers and business

people were belonged to high income group.

Food consumption pattern

The food consumption pattern was found to be non-vegetarian respondents are 260 respondents and only 40 respondents were vegetarians. The cereal, rice was found to be the staple food. They included wheat, maida flour and semolina in their diet. Millet's like jowar and bajra were consumed only by low income group respondents while ragi was consumed by high income group respondents. Pulses like red gram dhal and green gram were consumed by all the selected samples. Dried peas and Bengal gram were more common in study area while horse gram and cow pea were consumed only by high income group.

There was not much variation in the inclusion of vegetables between high and low income group. The high income group consumed fruits daily, but varied with the seasonal availability. Banana was the common fruit consumed by the all income groups. The nuts like coconut and groundnut were commonly used by all but varied in the frequency of inclusion. Groundnut oil and palm oil were used for cooking purposes. High income group used gingelly oil ground nut oil and occasionally butter and ghee.

Prevalence of diseases

Prevalence of disease among selected respondents is given in Table 1. The selected disease like hypertension, hypercholesterolemia, diabetes, obesity and constipation were more prevalent among high income groups than middle and low income groups. High income group subjects are engaged in business and job that's why they don't have time for exercise and eating patter is more fatty, bakery items and fast foods. That's why high income group subjects are suffered from these diseases.

Table 1. Prevalence of disease conditions among the respondents (N=300)

Disease condition	High income group	Middle income group	Law income group
Hypercholesterolemia	50 (16.17)	10 (3.34)	10 (3.34)
Hypertension	30 (10%)	15 (5)	15 (5)
Diabetes Mellitus	45 (15)	5 (1.6)	5 (1.6)
Obesity	40 (13.14)	40 (3.34)	5 (1.6)
Constipation	35 (11.67)	15 (5)	10 (3.34)

Note: Figures in parenthesis indicate percentages

Mean daily food intake

The mean daily food intake of selected respondents is presented in Table 3. The mean cereal intake of all the three income groups were less than the ICMR recommendation. The pulses intake of high income were above the recommended allowance of 40 gm. whereas in middle and high income group there was pulse intake is more than recommended allowance.

The consumption of green leafy vegetables was less than the recommendation in three income groups. With regards to roots and tuber's and other vegetables expect for the high income group in the other income groups, the intake did not meet the recommended allowance. The fruit consumption was greater among high income group than the others. It is noted that low income group did not include fruit in their diet. Milk consumption of the high income groups were above the recommended value while in low income group it was only 13.52 gm as against 260 ml. Except for low income group all the other income groups had a satisfactory intake of sugar and jaggery. With regards to fats and oils high income group intake is higher than other groups.

Lipid profile of selected subsample

Comparison of crude fiber intake and serum lipid profile with normal values of 15 subsamples in three different income levels are represented in Table 4. Regarding the serum lipid profile all the selected samples had normal cholesterol level irrespective of their fibre intake but it was higher in the high income group than the other two income groups. This may be due to the inclusion of saturated fats like butter, ghee, and the animal foods like egg and mutton. The serum triglyceride values decreased as the income levels of the groups decreased. This could be attributed to the fat and carbohydrate content of their diet. The low density lipoprotein cholesterol level was found to be proportionate to the serum cholesterol level. The high density lipoprotein cholesterol levels were found to be more in the low income and least among the high income groups.

Nutrient intake of the subjects during the supplementation period

The nutrient intake of the experimental group during supplementation period is compared with their nutrient intake before supplementation in Table 5. It is evident that there was a decrease in calorie content of the diets of the experimental group, during the supplementation period. The percent of decrease in calorie content of the diet ranged from 1.6 to 07 in middle and low income group and 12 percent in high income group. There was an increase in protein content by 4 percent in middle income group subjects and 13 percent in the obese, while in the high income group subjects was a decrease of 0.9 percent.

From the weightment survey, fat reduction was very evident in all the groups and the percent of decrease in the low income group, middle income

Table 2. Comparison of mean food intake with RDA (N=300)

Samples	Cereals (gm) (mean± S. D.)	Pulses (gm) (mean± S. D.)	Green leafy vegetables (gm) (mean± S. D.)	Roots & Tubers (gm) (mean± S. D.)	Other vegetables (gm) (mean± S. D.)	Fruits (gm) (mean± S. D.)	Milk (gm) (mean± S. D.)	Sugar & Jaggery (gm) (mean± S. D.)	Oil & Fat (gm) (mean± S. D.)
High Income group (S) respondents (N=90)	385.5 ± 19.2	60.22 ±12.3	35.88 ±13.5	82.42 ± 25.41	65.77 ± 10.11	78.23 ± 22.25	232.41 ± 40.12	35.23 ± 3.22	42.00 ± 5.10
Middle income group respondents (M) (N=90)	376.28 ±17.18	42.35 ± 8.23	32.52 ±10.11	31.23 ± 8.32	55.21 ± 18.91	8.35 ± 9.31	105.13 ± 34.26	37.52 ± 6.62	33.21 ± 8.32
Low income group respondent (H) (N=120)	397.12 ±23.31	35.32 ± 10.11	22.72 ± 11.70	29.25 ± 12.22	31.23 ± 11.42	Nil	13.52 ± 20.12	23.50 ± 7.32	30.25 ± 6.23
RDA Sedentary	460	40	40	50	60	NR	150	30	40
Moderate	520	50	40	60	70	NR	200	35	45
Heavy	670	60	40	80	80	NR	250	55	45

S = Sedentary working, M= Moderate working, H= Heavy working, NR= Not Recommended

Table 3. Comparison of the lipid profile with normal values (N=15)

Parameters	Normal values	High Income group	t-value	Middle income group	t-value	Low income group	t-value
Total Cholesterol (mg/100ml)	200	187.61± 19.3	067*	166.7 ± 10.3	0.31*	158.3±4	1.29*
HDL Cholesterol (mg/100ml)	55	51.5± 6.3	0.63*	53.6 ±4.5	0.04*	55.5 ±6.2	0.71*
LDL- Cholesterol (mg/100ml)	150	118± 17.8	1.18*	95± 8.9	0.57*	84.5± 8.5	0.23*
Triglyceride (mg/100ml)	150	122.3 ±34.7	1.11*	89.3±11.1	1.42*	57.5±10.1	0.22*

Not Significant at 5 percent level normal values (Srilakshmi, 2005)

Table 4. Comparison of the mean nutrient intake before and after supplementation (N=10)

Nutrient	High income group			Middle income group			Low income group		
	B.S.	A.S.	Percent of difference	B.S.	A.S.	Percent of difference	B.S.	A.S.	Percent of difference
Energy (Kcal)	2455±62	2173±87	-12	2338±41.2	2196±52.5	-7	2425±56	2386±60.2	-1.6
Protein (gm)	58.5±5.4	65.4±4.4	13	62.5±5.6	65.2±3.2	4	64.3±4.1	63.2±5.1	-0.9
Fat (gm)	59.5±11.5	39.3±6.2	-35	60.2±3.1	41.2±3.2	-33	49.3±6.4	36.3±0.9	-22
Carbohydrate (gm)	419±33.5	3.92±9.2	-6.4	393±10.1	395.2±9.2	0.95	44.33±23.1	449.5±29.2	3.9
Crude Riber (gm)	7.5±0.4	16.3±0.02	6	8.4±0.9	14.5±0.3	5	91±0.5	17.5±0.4	7

BS = Before Supplementation, AS = After Supplementation

group and high income group were 22, 33 and 35 respectively. High fibre diets tend to be low in saturated fat and the most important effect of fibre rich foods is to displace fatty acids. The crude fibre content of the low income group subject doubled from 9 gm to 17.5 gm while in the middle income group subject it increased from 8.4 gm to 14.5 gm. The increase in crude fibre content of the high income group subject was from 7.5 gm to 16.3 gm. This double increase in crude fibre content is due to the high fibre content of the supplemented diets.

Effect on serum lipids

There was a decrease in serum cholesterol level after supplementation of high fibre diet (Table 6). When compared with the control group, there was a decrease of 1 to 15 mg/100ml in the experimental group as against 2 mg/100 ml increase in the control group. It was statistically proved that, the change is significant at 5 percent level. Results of the lipid Research Clines Coronary Primary Preventive Trial Predict a two percent reduction in coronary heart disease for every one percent reduction in serum cholesterol (Farnandis and Aglawe, 1995).

There was no significant change in the HDL Cholesterol value after supplementation. The control group also showed no change. The LDL- Cholesterol level of the experimental group was decreased by 1 to 13 mg/100 ml. The change in the LDL- Cholesterol value was significant at both 5 percent and 1 percent level. A variety of vegetable and fruit supplements and whole grain added to a mixed diet of normal subjects resulted in a decrease in VLDL and LDL Cholesterol but not change in HDL – Cholesterol in

Table 5. Lipid profile of the individual samples before and after supplementation

Samples	Total cholesterol			HDL cholesterol mg/100ml			LDL-Cholesterol mg/100ml			VLDL-Cholesterol mg/100ml			Triglycerides mg/100ml		
	B.S.	A.S.	Difference	B.S.	A.S.	Difference	B.S.	A.S.	Difference	B.S.	A.S.	Difference	B.S.	A.S.	Difference
Experimental group High income subject (N=3)	250	190	-15	42	43	+1	127	114	-13	36	34	-2	180	170	-10
Low income subject (N=3)	178	180	-2	49	48	+10	103	95	-8	36	37	+1	181	185	4
Middle income subject (N=3)	161	160	-1	48	48	0	82	80	-2	32	32	0	160	158	-2
Control group High income subject (N=3)	200	205	0	54	54	0	127	117	-10	34	34	0	170	170	0
Middle income subject (N=3)	165	165	0	52	52	0	83	82	-1	30	31	+1	148	155	+7
Low income subject (N=3)	198	200	+2	56	57	+1	125	121	-4	22	22	0	110	110	0

B.S = Before supplementation period, A.S. = After Supplementation Period.

Table 6. Lipid profile of the individual samples before and after supplementation

Samples	Total cholesterol			HDL cholesterol mg/100ml			LDL-Cholesterol mg/100ml			VLDL-Cholesterol mg/100ml			Triglycerides mg/100ml		
	B.S.	A.S.	Difference	B.S.	A.S.	Difference	B.S.	A.S.	Difference	B.S.	A.S.	Difference	B.S.	A.S.	Difference
Experimental group High income subject (N=3)	250	190	-15	42	43	+1	127	114	-13	36	34	-2	180	170	-10
Low income subject (N=3)	178	180	-2	49	48	+10	103	95	-8	36	37	+1	181	185	4
Middle income subject (N=3)	161	160	-1	48	48	0	82	80	-2	32	32	0	160	158	-2
Control group High income subject (N=3)	200	205	0	54	54	0	127	117	-10	34	34	0	170	170	0
Middle income subject (N=3)	165	165	0	52	52	0	83	82	-1	30	31	+1	148	155	+7
Low income subject (N=3)	198	200	+2	56	57	+1	125	121	-4	22	22	0	110	110	0

B.S = Before supplementation period, A.S. = After Supplementation Period.

a study of Farnandis and Aglawe in 1995. There was decrease of 2.5 percent in the man serum triglyceride value after supplementation.

Conclusions

Present investigation conclude that the selected disease like hypertension, hypercholesterolemia, diabetes, obesity and constipation were more prevalent among high income groups than middle and low income groups. The serum triglyceride values decreased as the income levels of the groups decreased. This could be attributed to the fat and carbohydrate content of their diet. The low density lipoprotein cholesterol level was found to be proportionate to the serum cholesterol level. The high density lipoprotein cholesterol levels were found to be more in the low income and least among the high income groups. The crude fibre content of the low income group subject doubled from 9 gm to 17.5 gm while in the middle income group subject it increased from 8.4 gm to 14.5 gm. There was a decrease in serum cholesterol level after supplementation of high fibre diet. When compared with the control group, there was a decrease of 1 to 15 mg/100 ml in the experimental group as against 2 mg/100 ml increase in the control group. It was statistically proved that, the change is significant at 5 percent level. There was no significant change in the HDL Cholesterol value after supplementation. The control group also showed no change. The LDL- Cholesterol level of the experimental group was decreased by 1 to 13 mg/100 ml. The change in the LDL- Cholesterol value was significant at both 5 percent and 1 percent level.

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