Influence of a Family Diet Pattern High in Linoleic Acid on Serum Cholesterol Level: One Year Study.* (27702)

LEON SWELL, P. E. SCHOOLS, JR., AND C. R. TREADWELL
Veterans Administration Center, Martinsburg, W. Va., and Department of Biochemistry, School of Medicine, George Washington University, Washington, D.C.

It has been adequately demonstrated that ingestion of polyunsaturated fatty acids leads to a lowering of the serum cholesterol level in man(1). A number of approaches(2,3,4) have been utilized in attempts to increase the level of dietary polyunsaturated fatty acids. Recently, data were presented(5) on the effect of a practical family diet pattern for lowering the serum cholesterol level. Healthy subjects with initially elevated serum cholesterol levels showed a highly significant decrease in serum cholesterol level after 10 weeks on a family diet pattern rich in linoleic acid. All persons in the household in which each subject resided were placed on this dietary regimen and it was readily accepted by all. It was also observed(6) that after 10 weeks the subjects exhibited a highly significant increase in the percentage of linoleic acid in their serum cholesterol esters and triglycerides, with a concomitant drop in saturated and oleic acids. The present report describes the effects in the same subjects after one year on the dietary regimen. Limited data are available regarding the long-term effects of a practical diet for lowering the serum cholesterol level of healthy subjects with elevated serum cholesterol levels.

Methods and materials. The group consisted of 16 clinically healthy subjects. Initially, all had elevated serum cholesterol levels in the approximate range of 250 to 400 mg%. The family diet pattern high in linoleic acid has previously been described(5) and consisted of the substitution of up to one-half of the normal dietary fat (rich in animal fat) by vegetable fat (corn oil and a corn oil margarine). The diet contained 22% of the fat calories as linoleic acid. Blood samples were obtained at 4 weekly intervals prior to placing the individuals on the high linoleic acid diet and thereafter blood samples were obtained at monthly intervals for one year. No significant change in weight of the subjects while on the dietary regimen was noted.

Total serum cholesterol level was determined by the method of Sperry and Webb (7). Serum lipids were extracted and cholesterol esters and triglycerides isolated on silicic acid columns as previously described(8). Gas-liquid chromatography of the serum lipid fractions was carried out as described earlier (8). Statistical analyses were carried out by the "t" test and $P<.05$ was considered to be significant and $P<.01$ highly significant.

Results. Serum cholesterol levels. The data in Fig. 1 represent the average serum cholesterol level of the 16 subjects during the 52-week period. Average serum cholesterol of the group during the pre-dietary period was 293 $\pm$ 43 mg%. After the dietary regimen was instituted there was a sharp drop in serum cholesterol level at the end of 2 weeks, then the level further decreased until approximately the 10-week period(5). Thereafter, the level fluctuated around 225 $\pm$ 30 mg% to 235 $\pm$ 33 mg% throughout the remainder of the dietary period, with the exception of the 28-week value which was 214 $\pm$ 41 mg%. At the end of 52 weeks, the serum cholesterol level of the group showed a decline of aproxpimately 64 mg% or 21.8%. In Fig. 2 are shown the effects of the family diet pattern on 3 representative subjects.

Serum lipid fatty acid composition. The effect of the dietary regimen on fatty acid composition of the serum cholesterol esters is shown in Table I. The diet produced a highly significant increase in the proportion of linoleic acid and a smaller increase in the amount of arachidonic acid in the serum cholesterol esters, with proportionate decreases in percentages of saturated and monounsaturated fatty acids. At the end of one year on the dietary regimen, the percentage of poly-

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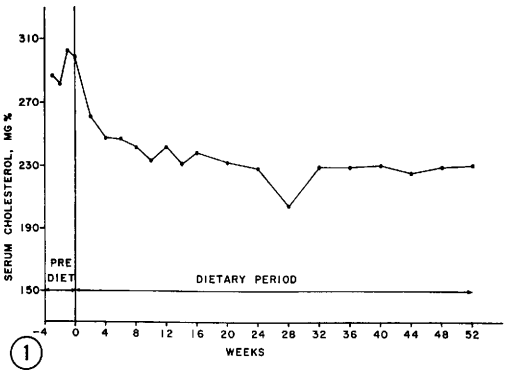

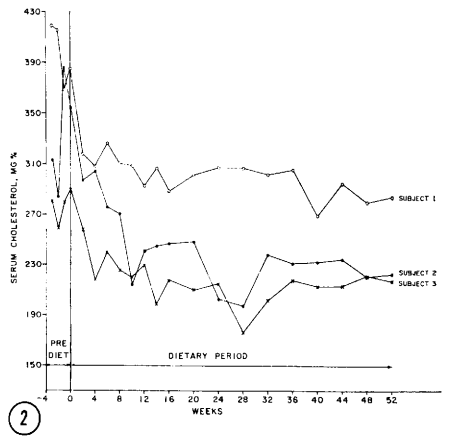

FIG. 1. Effect of family diet pattern high in linoleic acid on the serum cholesterol level of a group of 16 healthy subjects.

FIG. 2. Effect of family diet pattern high in linoleic acid on the serum cholesterol level of 3 representative subjects.

unsaturated fatty acids in the serum cholesterol esters had increased from 49.1 to 66.1%. The serum triglyceride fraction (Table II) also showed highly significant changes in fatty acid composition. The diet, after one year, produced a 2-fold increase in percentage of linoleic acid, with concomitant drops in percentages of saturated and monounsaturated fatty acids in the serum triglyceride fraction.

Discussion. The 52-week data indicate that such a diet is practical for long periods, both as to adherence to the regimen and to its ability to maintain a lowered serum cholesterol level. Regarding the effect of the diet on the serum cholesterol level, several important points can be made. Following the initial decline in serum cholesterol level, the average serum cholesterol level of the group remained constant during the remainder of the one-year dietary period. The serum cholesterol level stabilized at approximately 230 mg%. It thus appears that elevated serum cholesterol levels can be reduced to within a more acceptable range with a minimum of change in the dietary habits. To reduce the serum cholesterol level of such subjects to below 200 mg%, more severe restrictions may be necessary. However, it was previously observed(5) that in normal subjects with initial blood cholesterol levels averaging 212 mg%, serum cholesterol levels were reduced

TABLE I. Effect of High Linoleic Acid Dietary Regimen on Serum Cholesterol Ester Fatty Acid Composition.

Fatty acid*		% total fatty acids	
Chain length carbons	No. double bonds	Before dietary change	52 weeks on diet
6 to 12		.9 ± .2†	.9 ± .3
14	0	.9 ± .3	.7 ± .3
14	1	.3 ± .1	.2 ± .1
16	0	16.7 ± 2.7	12.0 ± 1.7
16	1	3.8 ± .9	2.6 ± 1.2
16	2	.3 ± .1	.2 ± .1
18	0	3.4 ± .9	.9 ± .4
18	1	24.5 ± 2.9	16.2 ± 2.2
18	2	42.9 ± 5.2	58.1 ± 5.5
18	3	.8 ± .4	.9 ± .5
20	0	.4 ± .2	.4 ± .1
20	3	.7 ± .3	.4 ± .1
20	4	4.4 ± .9	6.5 ± 1.3

* Represents the major fatty acids determined; small amounts of others were also detected. Values represent average of 16 subjects.

† Standard deviation.

TABLE II. Effect of High Linoleic Acid Dietary Regimen on Serum Triglyceride Fatty Acid Composition.

Fatty acid*		% total fatty acids	
Chain length carbons	No. double bonds	Before dietary change	52 weeks on diet
6 to 12		1.1 ± .2	1.5 ± .7
14	0	2.6 ± .6	2.4 ± 1.0
14	1	.4 ± .1	.4 ± .1
16	0	33.5 ± 3.6	27.5 ± 4.0
16	1	3.4 ± .8	4.3 ± 1.1
18	0	5.8 ± 1.0	3.7 ± 1.0
18	1	40.2 ± 2.6	35.0 ± 3.2
18	2	11.6 ± 2.5	23.6 ± 8.5
18	3	.7 ± .3	.7 ± .3
20	4	.7 ± .3	.9 ± .3

* See footnote to Table I.

to approximately 180 to 190 mg% by the family diet pattern.

Also, it was shown earlier(6) that the dietary regimen influenced serum lipid fatty acid composition. After a year of the dietary regimen the effect is even more pronounced, particularly in respect to the large increase in percentage of linoleic acid in the serum cholesterol esters and triglycerides. While this suggests an inverse relationship between serum cholesterol level and percentage of linoleic acid in serum cholesterol esters and triglycerides, it should be pointed out that the initial marked drop (10 weeks) in the level of the serum cholesterol was accompanied by a significant change in the fatty acid spectrum of the cholesterol esters(6); further changes in the spectrum (as indicated here) occurred during the latter part of the dietary period when the serum cholesterol level was stabilized.

Summary. Clinically healthy subjects with elevated serum cholesterol levels were placed on a family diet pattern high in linoleic acid for a one-year period. The diet produced a highly significant decrease in serum cholesterol level (from 293 to 230 mg%). The greatest decrease occurred during the first several months; thereafter the serum cholesterol level fluctuated around 230 mg%. The diet produced a marked increase in percentage of linoleic acid in the serum cholesterol esters and triglycerides, with concomitant drops in percentages of saturated and oleic acids. It is concluded that such a dietary regimen for lowering the serum cholesterol level is practical for long periods.

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Liver Lipid Peroxide Levels in Carbon Tetrachloride Poisoning.* (27703)

ROBERT E. PRIEST,† EDWARD A. SMUCKLER, OSCAR A. ISERI AND EARL P. BENDITT
Veterans Administration Hospital, and Department of Pathology, University of Washington School of Medicine, Seattle

The protective action of Vit. E in carbon tetrachloride poisoning has been shown by histological means in rat liver(1). Vit. E is also known to be a lipid antioxidant. On these bases it was suggested that Vit. E functioned in this form of poisoning to protect the cellular lipid from oxidation "hypothetically" called forth by carbon tetrachloride or its metabolites. It has also been shown that early in carbon tetrachloride poisoning there is a dislocation of ribosomes from lipoprotein membranes, and impairment of protein synthesis by the liver(2,3). The possibility that formation of lipid peroxides in the lipoprotein membranes may play a part in these changes was submitted to test.

Methods and materials. Male Sprague-Dawley rats were fasted for 16-18 hours prior to experimentation. The animals were intubated without anesthesia and 0.50 cc carbon tetrachloride (C.P.) per 100 grams body weight dissolved in an equal volume of mineral oil was administered by gastric tube. Control animals received only mineral oil. At

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