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Linseed Trial in Hyperlipidemic Patients

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Abstract

Background - Hyperlipidemia is an important cause of coronary artery diseases. Linseed contains large amounts of omega-3 fatty acids, and it has a major role in lowering serum lipid levels. This study evaluated the effect of linseed powder in patients who did not respond to regular diet regimens.

Methods - We conducted an interventional study (before and after) of 56 patients with hyperlipidemia that had not responded to a 3-month regular diet and had serum levels of total cholesterol >240 or TG>300 or LDL>160 or HDL<30 (mg/dl). We prepared the dose of 6 gr/day of linseed powder in the form of a biscuit and gave it to the patients for 3 months plus their regular diet regimen. The serum levels of lipids were measured before and after the 3-month intervention program. The data were analyzed using SPSS software with paired t-test.

Results - The mean (±SD) of serum level of total cholesterol before treatment was 258 (±55.59) mg/dl and afterwards was 232.05 (±41.47) mg/dl (P=0.0001). The mean serum triglyceride level before and after treatment was 289.92 (±126.57) mg/dl, and 225.07 (±82.58), respectively (P=0.0001). Also, the mean serum LDL decreased from 173.82 (±52.87) to 141.12 (±39.94) mg/dl (P=0.0001). However, no significant difference on HDL levels was found before and after intervention (43.89 (±25.66) vs. 43.53 (±13.84), P=0.85). Overall, the linseed powder regimen for 3 months decreased the total cholesterol by 10.2%, serum triglyceride by 22.33% and LDL cholesterol level by 18.8%. HDL level increased by 1.45%.

Conclusion - Linseed powder plus regular diet decreased the lipoprotein levels significantly. Thus, we recommend roughly 6 gr. daily consumption of linseed as a compliment of regular diet regimen in lowering the level of serum lipids ***(Iranian Heart Journal 2005; 6 (1,2): 37-42).***

Key words: hyperlipidemia ■ linseed ■ cholesterol ■ triglyceride■ LDL■ HDL■ diet

Cardiovascular diseases are a common cause of mortality and morbidity in the world, and hyperlipidemia is the major risk factor of these diseases. Primary and secondary cares showed that with interventional programs which result in decreasing serum lipid levels, the risk of coronary events will be decreased and also lead to regression of atherosclerotic plagues in coronary arteries.

Thus, the National Center of cholesterol in United States recommended interventional program in the general population.

This recommendation first emphasizes on diet and physical activities.

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Due to the genetic susceptibility, many subjects with hyperlipidemia may not respond to regular diet regimens alone.
In this case, drug therapy for lowering lipid levels is recommended.

Because of the high cost and the side effects of drug therapy, non-drug therapy is the primary step for controlling lipid levels.
The presence of fat in the diet is necessary for health status, and it provides the required energy, fatty acids and vitamins for bodily activities.[1]
Published studies confirm that cholesterol and triglyceride (TG) of serum has a direct relationship with the type and amount of daily fat consumption. Saturated fatty acids elevate the level of total cholesterol, and polyunsaturated and monounsaturated fatty acids decrease the cholesterol level.[2-4] The required fatty acids include omega-6 linoleic acid (LA) and omega-3 alpha linolenic acid (LNA). These fatty acids with polyunsaturated fatty acids (PUFA) must be provided through daily diet consumption.[5] WHO and FAO recommend that at least 15% of the daily-received energy be provided from fatty acids. Also, the ratio of LA to LNA must be between 5:1 and 10:1, and linoleic acid must provide 10 to 40% of daily energy supply.[1]
Linseed, or *Linum usitatissimum*, is a plant cultivated for extracting oil from its seed or using its fiber. Linseed oil is supplied from linolenic acid (LNA), and its combination is different in relation to type, size, seed and climatic conditions. In a study, 35g linseed oil (20.7g omega-3 LNA and 4.9g omega-6 LA) was extracted from each 100 grams of linseed.[6] In another study, it was shown that 52% fatty acid supplied in linseed was made from LNA and 17% from LA, and that also the ratio of PUFA to saturated fat was 6/9.[7] Linseed is the only plant oil which contains more than 50% LNA[8-10], and the rate of omega-3 fat of linseed is three times greater than that of fish oil.[6]
Published studies on the effect of omega 3 fat on serum lipids have almost always used fatty acid extracted from seafood (fish). There are a few studies of the effect of linseed on lipids of serum, and their results also are somewhat contradictory. Since linseed is the main source of omega 3 fatty acid, this interventional study was conducted to determine the effect of linseed powder on decreasing lipid levels in patients who did not respond to regular diet regimen.

Methods

We conducted an interventional study (before and after) in patients with hyperlipidemia who did not respond to the recommended 3-months regular diet regimens alone without drug therapy; i.e. their lipid levels (TG, Chol, LDL, HDL) did not change toward the normal level. In our formal definition, regular diet was defined as formal diet without animal oil, plant oil, red meat and any other internal components of sheep such as liver, kidney, etc., and the maximum consumption of yolk (of egg) allowed was 1 egg per week. We recruited 75 patients consecutively with convenience sampling method. All these patients gave informed consent before undergoing our linseed intervention program plus regular diet. We included subjects into the study whose cholesterol was >240 or TG>300 or HDL <30 and LDL>160. Subjects who did not give an informed consent, those who did not tolerate drug therapy due to any side effects and also patients with diagnosis of coronary artery diseases or cerebrovascular diseases or any other systematic diseases were excluded from our study.
The preparation of linseed oil is difficult and problematic and should be done in conditions without light. The lin fiber invokes bile acids and results in modifying

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the cholesterol level. In addition, consumption of linseed powder alone has an unpleasant taste. Thus, the linseed powder was converted to biscuit form for convenience and compliance of the subjects under study. Our laboratory analysis for determining the oil combination of linseed and preparation of biscuit package was conducted by The Iranian Agricultural and Industrial Company, Ghoncheh.

The laboratory analysis showed that linseed contained 39.3% oil, which was combined with linolenic acid (56.49%) and linoleic acid (10.08%). In the north of Iran, Ghoncheh Company is responsible for preparing linseed and the process of its disinfection. First, linseed is changed to powder and then converted to biscuits in formats of 12 gr. Each biscuit contains white wheat flour (2.008g), sugar powder (3.05g), vitamin C (0.24g), baking powder (0.001g), vanillin (0.001g) and water (0.7mL). Each package of biscuits contains 33 pieces for consumption, which was handed to the subjects. The daily dose of consumption for each subject was 6g linseed powder, prepared as 12g biscuits. These biscuits in addition to regular diet were used for 3 months in our intervention program.

The serum lipid level of each subject was measured before and after the 3-month regimens. LDL and HDL were measured by calorimetric end point, and TG and CHOL were measured by the end-point method. Out of the 75 subjects under study, 19 patients were excluded: 9 due to a lack of tolerating the taste of the biscuits and 10 patients were lost to follow up. The data of 56 subjects, whose compliance was confirmed by the accompanying person in our follow-up, were analyzed using SPSS software, and we used the paired t-test to determine the significant effect of our intervention program in decreasing the lipid levels.

Results

The mean age (±SD) of the participants was 56.2 (±6.9) years, with the range of 30-79 years, and 19 cases were male and 37 cases were female. The results showed that the mean cholesterol was 258.44 before and 232 after 3-months' intervention (P=0.0001). The mean difference was 26.39 mg/dl, and the decreasing rate was 10.2% (Table I). The mean difference in TG level was 64.85mg/dl, a decrease of 35%. The mean difference in LDL level was 32.7 mg/dl (P=0.0001), a decrease of 18.8%. The mean difference in HDL was 0.64 mg/dl, a 1.45% decrease (P>0.05).

Table I. The mean (SD) of serum lipids before and after intervention with linseed powder.

Serum lipid	Before treatment Mean ± SD (g/dl)	After treatment Mean± SD (g/dl)	P value
Total Cholesterol	258.44±55.95	232.05±41.47	0.0001
TG	289.92±126.57	225.07±82.54	0.0001
LDL	173.82±52.87	141.12±39.94	0.0001
HDL	43.89±25.66	44.53±13.89	0.85

Discussion

Our findings indicate that the consumption of linseed powder plus regular diet regimens significantly decreased the mean cholesterol, TG and LDL in both male and female subjects, but HDL level increased significantly only in females. These results are consistent with those reported that the consumption of polyunsaturated fatty acid leads to a decreased total cholesterol level.[2,4,11,12] In particular, the consumption of omega-3 fatty acid decreases the total cholesterol level.[13] However, Alekseeva et al.[14] and Eristland et al.[15] did not find any significant effect of linseed and omega 3

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fatty acid on cholesterol level. These differences might be due to the difference in social factors, genotype with respect to the hyperlipidemia, background diet, dose, method of prescription and the duration of follow-up. Moreover, Kim et al. reported that the consumption of linseed in patients with hyperlipidemia caused a decrease in total cholesterol level up to 25%.[6] This figure is much more than those we estimated in our study (10.2%).We used the least possible dose of linseed in order to prevent any side effect. Thus, the differences essentially might be due to the prescribed dose of linseed which we used. Although the consumption of omega 6 fatty acid induces a relative increase in serum cholesterol level,[16] linseed mostly contains omega 3 fatty acids.[9,10] According to many clinical researchers, this type of fatty acid is expected to decrease the plasma level of triglyceride. Our findings showed that the mean difference of TG was 64.8 mg/dl, a decrease of 22.3%. These results also corresponded to those reported about the effect of omega 3 fatty acid and linseed on TG plasma level.[7,9,10,17,18,19] Our findings did not correspond with those reported by Alekseeva et al., who showed that the consumption of linseed did not change TG level of plasma.[14] Kim et al. also reported that the daily consumption of linseed led to a 65% decrease in serum TG level.[6] We found that this figure was 22.3%. This difference might be due to the dose of linseed prescribed in our study (we used the least dose).

Our findings also revealed that LDL level significantly decreased by a mean of 32.7mg/dl, or 18.8%. This result is also consistent with those reported in the literature.[16,17,20-22] In contrast, Alekseeva et al. and Eristland et al. did not find any significant effect of omega 3 fatty acid on LDL levels.[15,16] The reasons we discussed already can explain these different results.

Published studies reveal that the consumption of omega 6 fatty acid leads to lowering in HDL level[23, 24] and that omega 3 fatty acid increases HDL level or does not change it at all. We also did not find any significant difference on overall HDL level. These findings also corresponded with those reported by Eristland et al,[15] while other published data in the literature have reported a significant increase in HDL level using omega 3 fatty acids.[17, 22]

In addition, when we conducted stratified analysis with respect to the gender, the findings revealed that our intervention program was effective in decreasing the total cholesterol, TG and LDL level in both males and females; however, HDL level tended to decrease in men. This might be due to the small number of men in the study, and also it did not achieve statistical significance. On the other hand, HDL levels increased significantly in females.

A limitation of using linseed oil is that it must be kept in a closed space and packed in dark houses since it is extremely susceptible for oxidation. Also, some kinds of linseed might contain unflavored combinations which could be toxic, such as glucose cyanogen. In particular, linseed used for cultivation of linen has greater risk than linseed oil, and oil linseed is much less susceptible for such toxigenic activity. The risk of this toxin is greater in premature seed than mature seed, and it can lead to cyanotoxin through hybridization.

According to the report of the Industrial Nutrition Institute of Iran, the major oil consumption in Iranian families is hydrogenous vegetable oil, which accounts for 22% of the total required daily energy. In addition, PUFA comprises only 1.5% of total energy, and its rate of consumption is much lower than recommended levels.[1,2] Taking into account that roughly 40% of mortality is due to cardiovascular diseases,[1] the pattern of consumption of nutrients, especially oil has an important

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role on overall health. Thus, a community-based intervention program and changing diet behavior, particularly in urban areas is required to modify the present pattern of oil consumption. In this regard, we recommend roughly 6g daily consumption of linseed powder as a compliment of the regular diet regimen for lowering lipid levels.

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