Eggplant (*Solanum melongena*) Extract Does Not Alter Serum Lipid Levels

Juliana Marchiori Praça, Andréa Thomaz, Bruno Caramelli

São Paulo, SP - Brazil

Objective - *To compare the effect of eggplant extract on serum lipid levels with that of lovastatin.*

Methods - *The study included 21 individuals of both sexes, with total cholesterol (TC) levels > 200 mg/dL, no diabetes, no contraindication for the use of statins, and no use of cholesterol-lowering drugs, divided into the following 3 groups: 1) the eggplant group (B), in which the patients drank 1 glass of eggplant extract with orange juice before breakfast each morning; 2) the statin group (E), in which the patients received 20 mg of lovastatin in the evening after dinner; 3) control group (C), in which the patients received no treatment. Total cholesterol and fractions (HDL, LDL), and triglycerides were measured 3 times at 3-week intervals.*

Results - *The baseline lipid levels were similar in the 3 groups. After 6 weeks, a significant reduction in TC levels (from 245.29 ± 41.69 to 205.71 ± 46.45; P=0.02) and in LDL-cholesterol levels (from 170.83 ± 41.76 to 121.29 ± 44.90; P=0.008) was observed in group E. In group B, total cholesterol (from 230.60 ± 19.30 to 240.20 ± 16.22; P=0.27) and LDL-cholesterol (from 139.60 ± 21.49 to 154.40 ± 9.66; P=0.06) showed no statistically significant variation, as in group C. No significant variation was observed in the HDL-cholesterol and triglyceride levels in the 3 groups throughout the study.*

Conclusion - *The eggplant extract with orange juice is not to be considered an alternative to statins in reducing serum levels of cholesterol.*

Keywords: ischemic heart disease, dyslipidemia, eggplant

Instituto do Coração do Hospital das Clínicas - FMUSP
Mailing address: Juliana Marchiori Praça - Rua Teodoro Sampaio, 363/810
Cep 05405-000 - São Paulo, SP, Brazil - E-mail: julipraca@hotmail.com
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Cardiovascular diseases are the first cause of death in Brazil. This classification includes cerebrovascular disease and ischemic heart disease, which have arterial atherosclerosis in common as a pathophysiological basis. These diseases, most of the time, have an abrupt on set, requiring the development of strategies for primary and secondary prevention.

The prevention of cardiovascular diseases involves the recognition of their risk factors, wHich if controlled, decreases the incidence of these diseases [1,2]. A 1% reduction in cholesterol level was shown to correspond to a 2% reduction in the probability of cardiovascular events[1].

The treatment of hypercholesterolemia requires a reduction in the intake of food with a high content of saturated fat (of animal origin), rich in cholesterol. Medications are the second step in the treatment. Some studies have shown that statins reduce cholesterol levels in approximately 20% and the incidence of cardiovascular events and mortality in up to 22%[2]. The treatment with statins, however, has a very high cost, hindering the use of those drugs in the general population, which explains the constant search for more economic alternatives. Especially in Brazil, the high cost of this treatment may be responsible for the low index of use of statins observed in clinical practice[3].

The objective of this study was to check the efficacy of eggplant (*Solanum melongena*) extract combined with orange juice in acting as a reducer of serum lipid levels compared to the efficacy of lovastatin.

Methods

Twenty-one individuals of both sexes with total cholesterol above 200 mg/dL were selected. Individuals with contraindications to the use of fibers, diabetic individuals, and those using cholesterol-lowering drugs were excluded from the study.

The number of individuals in each group was based on the mean value of total cholesterol reduction with lovastatin of 20%, and the standard deviation estimated for each group of 0.10, because they were homogeneous groups, meeting the following 2 inclusion criteria: baseline total cholesterol level > 200 mg/dL and the absence of treatment. Individuals with total cholesterol much greater than that value

are usually under treatment, and, therefore, were not included. To be considered an alternative to lovastatin, the reduction expected with the eggplant extract should be ≥ 20%. Considering a study power of 80% and an α value of 0.05, we obtained 4 individuals for each group. Considering the possibility of nonadherence to treatment with eggplant extract during the entire study period, we decided to assess 21 individuals. These individuals were randomly divided into 3 groups, and for 6 weeks they underwent the following therapeutic regimen: 1) group C: control group – no treatment; 2) group B: 1 glass of eggplant extract with orange juice in the morning, before breakfast; 3) group E: 20 mg of lovastatin everyday after dinner.

The individuals were recommended to maintain their usual diet and physical activities during the entire study period.

Three measurements of total cholesterol levels, HDL-cholesterol levels, and triglyceride levels were taken, in addition to the calculation of the LDL-cholesterol level using the Friedewald formula (when the triglyceride levels were lower than 400 mg/dL), with a portable Cholestech-LDX [4-6] (Analyzer, Cholestech Corporation, Hayward, CA, USA). The first measurement was taken at the beginning of the experiment; the second measurement was taken at the end of the 3rd week; and the 3rd measurement was taken at the end of the 6th week.

The eggplant extract with orange juice was prepared from a medium "Japanese" eggplant (approximately 200 g), 2 oranges or natural orange juice in cartons (200 mL), and sugar or sweetener. The eggplant with skin was cut into cubes and processed in a blender with the orange juice and sugar or sweetener for approximately 1 minute at medium velocity until a homogeneous mixture was obtained. The individuals were instructed to properly prepare the mixture and to drink 1 glass (250 mL) of the preparation in the morning while fasting.

The project was submitted to and approved by the Committee on Ethics for Assessment of Research Projects of the Hospital das Clínicas of the University of São Paulo.

Only the individuals who followed the instructions were considered for the results, ie, those taking the medication or the properly prepared eggplant extract with orange juice for at least 75% of the time determined. This information was assessed by means of a questionnaire. The data obtained were analyzed with the paired *t* test, and the significance level adopted was 0.05.

Results

Twenty-one individuals, 9 of whom were men, were studied, divided into 3 groups. Group C had 7 individuals, group B had 6, and group E had 8. The statistical analysis of the data showed that the individuals in the 3 groups were statistically similar in regard to their baseline characteristics (tab. I).

The treatment administered to the individuals in groups B and E was well accepted, and no side effects occurred.

Both total cholesterol and LDL-cholesterol in group E individuals significantly decreased with treatment (figs. 1 and 2). The total cholesterol levels decreased from 245.29 ± 41.69 to 205.71 ± 46.45, P=0.02, and the LDL-cholesterol levels decreased from 170.83 ± 41.76 to 121.29 ± 44.90, P=0.008.

The reduction in total cholesterol and in LDL-cholesterol due to statin use occurred in the first 3 weeks of treatment (no significant difference was observed between the values of the 3rd and 6th weeks), the reduction in total cholesterol with statin use being approximately 19.24%.

In group B individuals, neither total cholesterol (230.60 ± 19.30 to 240.20 ± 16.22, P=0.27), nor LDL-cholesterol (139.60 ± 21.49 to 154.40 ± 9.66, P=0.06) significantly varied throughout the study (figs. 1 and 2). Although very close to statistical significance (P=0.06), in group B, a trend towards an increase and not a decrease in total cholesterol was observed. In group C individuals, neither total cholesterol (from 235.17 ± 16.33 to 222.17 ± 24.56, P=0.85), nor LDL-cholesterol (150.50 ± 13.50 to 147.83 ± 27.08, P=0.98) significantly varied during the study (figs. 1 and 2).

Table I - Baseline levels of serum lipids in the 3 groups studied

	B	C	E	P
TC	230.6 ± 19.3	235.17 ± 16.33	245.29 ± 41.69	0.63
HDL	64.4 ± 21.73	46.33 ± 9.03	45.43 ± 14.06	0.07
LDL	139.6 ± 21.49	150.5 ± 13.5	170.83 ± 41.76	0.19
TRG	133.2 ± 30.03	191 ± 79.24	214.14 ± 116.3	0.25

B - eggplant group; C - control group; E - statin group; TC - total cholesterol; TRG - triglycerides; HDL - high-density lipoprotein; LDL - low-density lipoprotein.

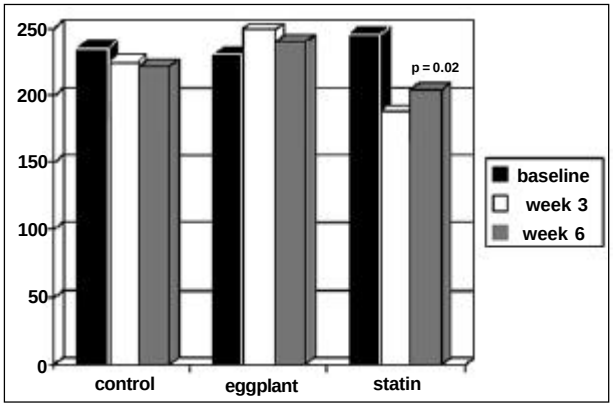

Fig. 1 - Total cholesterol levels in the 3 groups during the study.

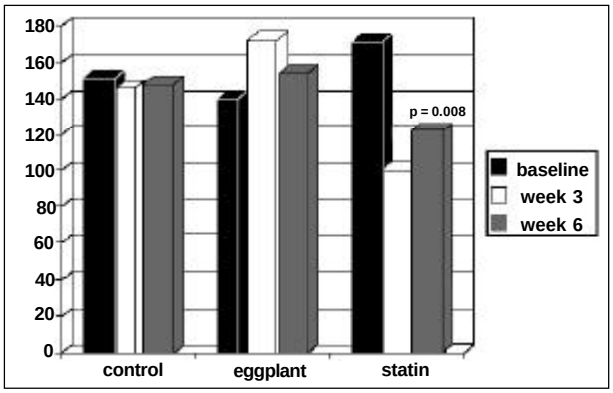

Fig. 2 - LDL-cholesterol levels in the 3 groups during the study.

No significant variation was observed throughout the study in HDL-cholesterol and triglyceride levels (tabs. II and III).

Discussion

Despite the lack of scientific evidence, the preparation of eggplant extract with orange juice has been recommended as an alternative treatment to reduce cholesterol levels for preventing cardiovascular diseases. This belief has been widespread in Brazil, and more than 500 sites can be found on the Internet with this recommendation. Most sites refer to eggplant as an excellent option, capable of reducing cholesterol up to 30%. This therapeutic option, if effective, would be interesting due to its low cost, and consequent greater accessibility for the population.

In fact, experiments performed with mice and rabbits have shown that the introduction of eggplant into their diet reduces the absorption of cholesterol, and, consequently, its serum levels [7,8]. In an experimental study with rabbits, Ribeiro Jorge et al [12] reported a significant beneficial effect of eggplant extract on cholesterol levels, lipid peroxidation, and endothelial function. However, in this study, the group of rabbits fed a cholesterol-rich diet with babaçu coconut fat and eggplant underwent a very significant weight loss (mean of 12.25%). This result could indicate a process of malnutrition, explaining the reduction in cholesterol levels and the other effects observed in the study. The authors have also considered the weight loss significant, interpreting it as secondary to the high fiber content found in eggplant (0.7 g, on average) [8]. It would be interesting if this finding could be confirmed with further studies that could show a weight loss of this magnitude due to a diet with a similar amount of fiber.

In a pilot experiment [9] with human beings, we assessed the effect of eggplant extract with orange juice in 19 healthy individuals. Comparing the values before and after 3 weeks of treatment, we observed no significant variation in total cholesterol (198 ± 36 and 202 ± 41 mg/dL; P=0.57), in LDL-cholesterol (123 ± 32 and 129 ± 32 mg/dL; P=0.40), in HDL-cholesterol (56 ± 14 and 55 ± 13 mg/dL; P=0.66), in triglycerides (90 ± 46 and 85 ± 37 mg/dL; P=0.70), and in fibrinogen (310 ± 54 and 289 ± 65 mg/dL; P=0.32). This pilot experiment, however, comprised individuals with total cholesterol < 200 mg/dL and covered a period of observation of 3 weeks, which may not have been sufficient to analyze occasional effects of eggplant extract.

Table II - HDL-cholesterol levels in the 3 groups studied over 6 weeks

	Baseline	Week 3	Week 6	P
B	64.4 ± 21.73	50.4 ± 11.68	60 ± 16.22	0.49
C	46.33 ± 9.03	47.5 ± 10.02	46.17 ± 10.17	0.93
E	45.43 ± 14.06	45.14 ± 17.12	46.86 ± 16.63	0.99

B - eggplant group; C - control group; E - statin group; Baseline - initial level; Week 3 - level at the end of the 3rd week; Week 6 - level at the end of the 6th week.

Table III - Triglyceride levels in the 3 groups studied over 6 weeks

	Baseline	Week 3	Week 6	P
B	133.2 ± 30.03	136.4 ± 35.99	130.8 ± 24.3	0.97
C	191 ± 79.24	158.83 ± 60.82	140.5 ± 73.08	0.52
E	214.14 ± 116.3	222.14 ± 100.11	189.43 ± 67.14	0.94

B - eggplant group; C - control group; E - statin group; Baseline - initial level; Week 3 - level at the end of the 3rd week; Week 6 - level at the end of the 6th week.

In a study using a 2% eggplant infusion, Guimarães et al [10] reported a transient and modest effect of eggplant infusion on cholesterol levels, which did not differ from that observed with the usual diet for hypercholesterolemic individuals. The authors suggest that the lack of efficacy of eggplant could be explained by its low concentration in the infusion (2%); in the study by Ribeiro Jorge et al [8], the eggplant concentration in the juice administered to the rabbits was 58%. In the present study, the eggplant concentration in the orange juice was approximately 50%, similar to that in the study by Ribeiro Jorge et al, but no trend towards a reduction in cholesterol was observed.

The benefit of the diet with a low cholesterol content and of the statins on serum lipids is unequivocal [1,2]. Until the present time, this treatment should be recommended for primary and secondary prevention of atherosclerosis in hypercholesterolemic individuals, and it is part of the III Brazilian Guidelines on Dyslipidemias and Guidelines on Atherosclerosis Prevention of the Department of Atherosclerosis of the Brazilian Society of Cardiology [11]. We emphasize that an alternative therapeutic option, such as that of eggplant, is not based on sufficient scientific evidence and, therefore, should not be recommended.

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