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The Effects of Hydro-Alcoholic Extract of Celery on Lipid Profile of Rats Fed a High Fat Diet

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ABSTRACT

Background and Objectives: Decrease in serum lipids by dietary or pharmacological intervention prevents progression of atherosclerosis and cardiovascular diseases. The aim of this study was to investigate the effects of hydro-alcoholic extract of celery (Apium graveolens) on lipid profile of rats fed a high fat diet. **Materials and Methods:** In this experimental study, 24 Wistar rats were randomly allocated into four groups. The control group received saline with high-fat diet and treatment groups did hydro-alcoholic extract at doses of 100 and 200 mg/kg/BW with high fat diet by gavage over a 30-day period. Afterwards, the serum levels of lipids (triglyceride, cholesterol, LDL, HDL, and VLDL) were determined. The data were analyzed by one-way ANOVA test using SPSS15 software. **Results:** Hydro-alcoholic extract of celery significantly decreased cholesterol and LDL in treatment groups compared with control group ($P \leq 0.05$); but had no significant effects in serum levels of triglyceride, HDL, and VLDL ($P > 0.05$). **Conclusions:** Probably celery consumption due to the antioxidant properties leads to appropriate changes in serum lipid profiles and reduces them. Therefore it could be useful in the treatment of hyperlipidemia.

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INTRODUCTION

Cardiovascular disease is the main cause of death around the world [1]. Increasing the concentration of LDL cholesterol is a major risk factor for cardiovascular disease [2].

According to statistics published, more than one hundred million Americans are infected with hypercholesterolemia and approximately 50 million of these people are in need of treatment [3,4]. High levels of fat can harden the arteries, or accelerate the atherosclerosis process and it is considered as one of the five leading causes of death in the world [5]. The manner of the metabolism, the amount and type of plasma fats, especially lipoproteins in triggering and exacerbating the cardiovascular disease are effective [6]. Considerable evidence exist that reducing cholesterol - LDL, through diet or through the use of lipid-lowering agents, primarily statins, can reduce the incidence of cardiovascular disease [7-10]. Chemical synthetic lipid-lowering medications have the side effects. Recently the use of remedies and natural herbs has been prevalent because people and are doctors have always been looking for effective, fast and low cost treatments. Among the medicinal plants in traditional medicine can be pointed to the celery with multiple health benefits. Celery (Apium graveolens) is a two-year plant with aromatic, branched stems and belongs to the family Apiaceae [11]. This plant is native to the Mediterranean region that is cultivated in other parts of the world [12]. Leaves and stalks of celery contain phenols, furanocoumarin, psoralen, bergapten, fully and xanthotoxin that their amount is changing from 12 to 50 mg /kg [13].

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Water of leaves and roots of celery is effective on biochemical parameters such as glutathione, catalase activity, glutathione peroxidase, xanthine oxidase, and peroxidase and lipid peroxidation in liver homogenated and blood hemolyzed and when used in combination with doxorubicin makes a protective effect against it [14]. Celery contains anticoagulant activity of blood plasma as well as the prevention of cardiovascular disease [15]. Celery root leads to increase in calcium and reduce in potassium within the heart tissue [16].

Sodium and potassium in celery help the body's fluid can be regulated and raises urine production, and it is an important aid for the withdrawal of excess fluid of the body [17]. In experimental studies have mentioned antifungal effects [18] and anti-inflammatory effects of the celery plant [19]. In recent years, a lot of studies have been focused on prevention and treatment of obesity on the biological effects of phenolic compounds. Phenolic compounds and flavonoids have pharmacological features such as anti-oxidants, anti-mutagenic, anti-thrombosis, anti-inflammatory, anti-cancer, and hyperlipidemia. These compounds typically have a wide distribution in plants and make up a part of the human diet [20]. Flavonoids cannot be produced in the human body and they are absorbed by the body through the daily diet. Evidence suggests that flavonoids play biological vital roles, including clearing the active oxygen species [21]. Celery is rich in antioxidant compounds such as flavonoids (such apiin and apigenin), vitamins E and C [22,23]. In recent years because of increased mortality due to heart disease - as well as vascular complications of synthetic drugs, research on medicinal plants and its effect on lowering blood lipids have been strong. The purpose of this study was to evaluate the effect of hydro-alcoholic extract of celery leaves on serum lipids rats fed with a high-fat meal.

MATERIALS AND METHODS

In this experimental study, 32 male Wistar rats, with a weight range of 170- 220g, made of animal reproduction Center, Ahvaz University of Medical Sciences, were used. Animals were kept in plastic cages in a room with the right environmental conditions and a temperature of about 22-24 ° C and 12 hours of light and 12 hours of darkness. Unlimited food and water were available to livestock. All other conditions for the maintenance of the rats were same and remained unchanged during the reviews. In this study, the code of conduct was met based on the ethical Protocol of guide for use of care laboratory animals published by the National Institute of Health.

Preparation of hydro-alcoholic extract of celery from celery leaf:

Celery plant purchased from one of the reputable shops in Ahvaz and then was detected and confirmed as A. graveolens species by the Pharmacology Department, Faculty of Pharmacy, Ahvaz Jundishapur University. After drying, celery leaves were converted by the electric mill and was kept in the refrigerator until extracting time. For the preparation of hydro-alcoholic extract, 50 g of edible powder of celery leaf was solved in 200 ml of ethanol 70% and the desired solution was mixed for three days at the temperature of 20-25 degrees Celsius using electrical sieve shaker. After 72 hours mix passed through Whatman's filter paper and for a filtered solution was put up in the Ben Murray to evaporate the solvent. The extract obtained was kept at a temperature of 4°C up to the time of use. The powder obtained from extracts of the leaves of celery, with the use of the solvent in Physiology serum, concentrations of 100 and 200 mg/kg/ B. W was prepared [24].

Grouping animals and prescribed an extract:

Rats were randomly divided into four groups of eight:

The first group: control group; the second group: (Sham) Physiology serum + a rich mixture of triglycerides and cholesterol; the third group: the use of low-dose (100 mg/kg) hydro-alcoholic extract+ a rich mixture of triglycerides and cholesterol; the fourth group: the use of low-dose (200 mg/kg) hydro-alcoholic extract+ a rich mixture of triglycerides and cholesterol.

For the preparation of high-fat diet (a mixture rich in triglycerides and cholesterol), animal planet (triglyceride-rich) and egg yolk (rich in cholesterol) can be separated, and 1 ml of mixture with an equal volume of them will be prescribed each of the rats. Animals received extract and the full-fat diet for 30 days and once every 24 hours. One day after the last injection, Animals underwent anesthesia with xylazine (10 mg/kg) and ketamine (60 mg/kg) (taken from the Alfasan company -Netherlands); then, blood samples were taken from the heart, and in each case were centrifuged at 3000 RPM for 15 minutes to separate the serum from the clot. Data from the hormonal assays were analyzed using statistical software SPSS15 and the analysis of variance test and comparative testing LSD by taking a significant level of $P \leq 0.05$.

Results:

Comparison between the mean and standard deviation of serum lipid concentrations in the experimental group were presented in table 1. As table.1 shows, unlike the control group, in the sham group the serum cholesterol concentration increased. But unlike the sham group, in the experimental group receiving the

concentrations of 100 and 200 mg/kg of hydro-alcoholic extract of celery leaves cholesterol concentrations have had a significant decrease, ($P \leq 0.05$) (figure.1).

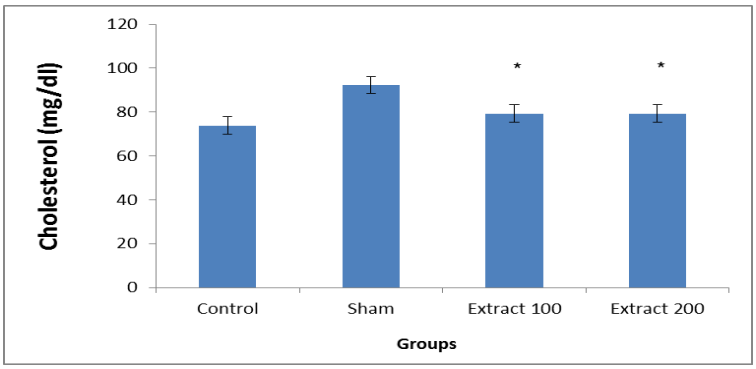

Fig. 1: Comparison of MEAN ± SE of serum level of cholesterol in case and control groups.
* (P<0.05) indicating significant differences between experimental and control groups

The effect of the hydro-alcoholic extract of the celery leaves on concentration of serum LDL:

The concentration of LDL despite had increased in sham Group compared to the control group, but in the experimental group receiving the concentrations of 100 and 200 mg/kg of hydro-alcoholic extract of celery leaves, a significant reduction was observed compared to the Sham group ($P \leq 0.05$) (figure. 2).

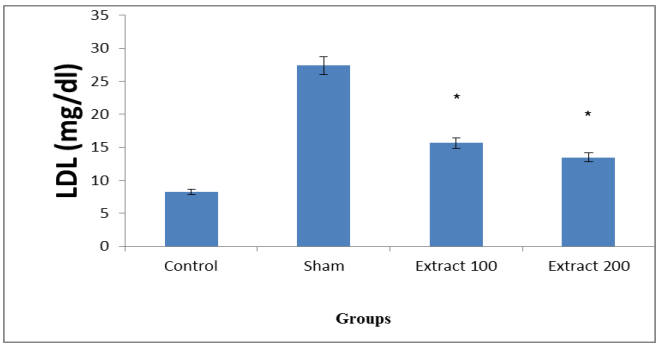

Fig. 2: Comparison of MEAN ± SE of serum level of LDL in case and control groups.
* (P<0.05) indicating significant differences between experimental and control groups

The effect of the hydro-alcoholic extract of the celery leaves on concentration of VLDL, HDL and serum triglyceride levels:

As it can be observed in table 1, no significant difference existed between the average serum concentration levels of VLDL, HDL and triglyceride in the experimental, control and sham group do ($P > 0.05$).

Table 1: Comparison of MEAN ± SE of serum lipid levels between the experimental groups and control group.

Groups	TG (mg/dl)	Cholesterol (mg/dl)	LDL	VLDL	HDL
Control	106.37±4.08	73.87±1.36	8.22±2.72	21.27±0.81	44.75±2.12
Sham	105.75±4.56	92.25±2.83	27.38±2.05	21.73±0.89	43.12±2.19
Experimental (100 mg/kg)	105.87±14.77	79.37±3.96*	15.67±4.1*	21.27±3.02	43.62±2.6
Experimental (200 mg/kg)	107±6.83	79.37±0.8*	13.47±2.02	21.4±1.36	44.5±2.48

Discussion:

In recent years the prevalence of hyperlipidemia and cardiovascular disease has increased markedly. Several investigations have been carried out in this field in order to find an effective, low complication and low cost drug in reducing blood lipids [25].

In the research the effects of the hydro-alcoholic extract of the celery leaves on serum lipids in the rats were examined. The results showed an increase in the cholesterol levels and serum LDL after administration of high-fat diet. Due to the high fat diet, the amount of chylomicron, triglycerides and cholesterol goes up, and then LDL increased [26]. A direct linear relationship between the blood cholesterol levels and cardiovascular disease

is observed [27-29]. In this study, following the celery extract administration, cholesterol and serum LDL levels in the test group animals decreased. This is consistent with the results of previous studies [30-32]. In a study, Tsi et al. examined the attributes of anti-hyperlipidemia of the hydroalcoholic celery in the rat. At the end of the experiment a significant reduction was observed in the concentration of serum total cholesterol, triglyceride levels and hepatic lipase triacyl glycerol in the treatment group [32]. The results of this study were consistent with the findings of the present study. Numerous studies have shown the damage caused by oxidative stress and free radicals are involved in causing dangerous disease, such as diabetes and atherosclerosis and cardiovascular disease [33-38]. In natural conditions, on the one hand, a balance exists between the production of free radicals and active oxygen species and the power of antioxidant defense system on the other hand, but if the production of free radicals increases or immune system weakens, damages caused by free radicals are possible. Flavonoids are among the secondary metabolites of compounds plant that cannot be synthesized by the human body and must be received through diet. Celery is among the plants that are rich in flavonoids such as apigenin and apiin. As well as this plant contains vitamins E and C, which have powerful antioxidant properties [22,23]. In a study of the effect of aqueous extract of celery on blood fat that had genetically hypercholesterolemia (RICO), Daniel et al. showed that Serum total cholesterol concentrations in RICO rats, has had a significant reduction. In addition, injection of the aqueous component and butanolic component for seven days more effectively reduced the total cholesterol in the rats. Eight weeks of injection of extract increase excreted cholesterol and its metabolites [30]. The results of this study were in line with our findings. In another study, Chang *et al*. showed that celery seed extract has a hyperlipidemia activity and also has a role in cleanup of free radicals due to the antioxidant property [39]. Lipid peroxidation may be communicated through the regulation of collagen gene expression between tissue damage and liver fibrosis [40]. Metabolism and decreased antioxidant levels in patients with hyperlipidemia leads to an increase in free radical blood. The presence of free radicals and in combination with LDL leads to disruption of lipid membranes and the incidence is atherosclerosis but plants like celery due to its antioxidant property, are able to remove free radicals and prevent the development of complications. In a study conducted by Abdolmadjid about regulatory effects of celery and two other plants (Cichorium intybus, and barley) on lipid metabolism and also prevention from the fatty liver, biochemical analysis of serum liver enzymes and blood lipids showed that eating 10% of celery alone lowers liver enzyme levels and blood fats and eat a combination of three plants more significantly reduces ALT,, AST ALP and lipid [28]. Mechanism of hypercholesterolemia action of celery extracts (aqueous and butanolic) presumably is due to the presence of sugar compounds or amino acid side chains [28].

Conclusion:

According to the results of this study, celery and its antioxidant compounds can serve as a good herb, available in fewer complications and be used for reducing lipid peroxidation, blood fat, the risk of cardiovascular disease or even in the treatment of hyperlipidemia. Subsequent research about total celery extract and its effect on hyperlipidemia is recommended.

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