The Beneficial Dietary Hypotensive and Hypolipidaemic Effects of Hyphaene Thebaica (Doum)

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Citation

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Abstract

Background: The use of Doum palm fruit which is rich in flavonoids (polyphenols) , saponins and tannins in folk medicine is not surprising.
Objectives: This study was done to clarify the role of Doum (Hyphaene thebaica), as a medicinal plant containing flavonoids, saponins and tannins, on blood pressure, blood lipids and lipoproteins in hypertensive patients.
Methods: Thirty female patients who were hypertensive, obese and hyperlipidemic were used in the study that extends to 3 months. They were divided into 2 groups each group consisted of 15 patients (control group received antihypertensive drug with similar dose, and Doum group received the same antihypertensive drug with the same dose. and agreed to consume an oral supplement of Doum in a daily dose of 25 mg/kg body weight). Blood pressure, plasma lipids and lipoproteins were followed up in all patients for 3 months. Blood samples were obtained after a 12 to 14 h fast. Concentrations of total cholesterol, triglycerides, HDL, apoA-I and apoB were measured. LDL was calculated according to the Friedewald equation.The recorded values were expressed as means and standard deviations (Mean ±SD). The statistical analyses were performed using the SPSS statistical Package version 12. Results: Compared with the control patients, supplementation with Doum caused a significant decrease in systolic blood pressure, diastolic B.P., total cholesterol, triglycerides, LDL, apoB-concentrations and LDL/HDL ratio, while significantly increasing the concentrations of HDL and apoA-I. Conclusion:These results confirm the benefits of Doum including lowering blood pressure in hypertensive patients and changing blood lipids and lipoproteins in a manner that decreases the risk on the cardiovascular system. More studies are needed support these benefits of Doum.

INTRODUCTION

Doum (Hyphaene thebaica) is an African palm tree, common in Upper Egypt, originally native to the Nile valley, bearing an edible fruit which is glubose-quandrangular , about 6 x 5 cm with a shinny orange-brown to deep chestnut skin (epicarp).The rind (mesocarp) in some palm is unedible but of other it is very palatable , highly aromatic and sweet with a taste like ginger bread hence the English name. When eaten it serves as vermifuges and parasite expellant (Burkill,1997). The chloroform extract of the fruits improve spermatic count of male rats at low concentration (Hetta and Yassin 2006) but decrease it at high concentration(Hetta et al., 2005) .

It was considered sacred by the Ancient Egyptians and its seeds were found in many pharaoh's tombs e.g Tutankhamun's tomb (Hetta et al., 2005).

The fruit has nutritional and pharmacologic properties.

Doum extracts are being used in the treatment of bilharziasis, haematuria, bleeding especially after child birth (Adaya et al., 1977) and also as hypolipidemic and hematinic suspension (Kamis et al., 2003). The tea of Doum is popular in Egypt and believed to be good for diabetes. It has been used by Egyptian people as a folk medicine for treatment of hypertension (Hetta et al., 2005).

Roots of doum were used in treatment of Bilharziasis, while the resin of the tree has demonstrated, diuretic, diaphoretic properties and also recommended for tap worm as well as against animal bites (L.Boulos ,1983).

Sharaf et al. (1972) showed that the aqueous extract of Doum stimulated the contractions of frog's heart and rat intestine but inhibited uterine contractions in rats. On the arterial blood pressure, the extract proved to be capable of lowering the blood pressure both in normotensive and hypertensive anaesthetised dogs. Meanwhile, Hetta and

Yassin (2006) reported that constituents of the Doum exhibited a significant decrease in serum total cholesterol and Non-HDL cholesterol in rats; this can reduce the risk of atherosclerosis and subsequent cardiovascular diseases.

The use of some plants as medicinal plant is due to the presence of flavonoids and saponins (Waterhouse 2003). Doum was reported to contain important substances including saponins, tannins, and flavonoids (Dosumu et al., 2006); hence the use of Doum, which is rich in flavonoids and saponins, in folk medicine is not surprising.

Oral administration of grape flavonoids (polyphenols) has been shown to inhibit platelet function (Freedman et al., 2001), and reduce thrombus formation (Demrow et al., 1995). At the vascular wall level, polyphenols exert vasorelaxant effects (Zenebe et al., 2003), inhibit the adhesion of monocytes to the endothelium (Carluccio et al., 2003; Badía et al., 2004), and improve endothelial function (Stein et al., 1997). Finally, polyphenols have been shown to reduce the development of atherosclerosis in animal models (Stocker and O'Halloran 2004; Waddington et al., 2004).

Hypertension is a major health problem throughout the world because of its high prevalence and its association with increased risk of cardiovascular disease. The higher the blood pressure the greater the chance of myocardial infarction, heart failure, and stroke. For individuals aged 40–70 years, each increment of 20 mmHg in systolic blood pressure(SBP) or 10 mmHg in diastolic blood pressure(DBP) doubles the risk of cardiovascular disease (Chobanian et al., 2003).

Chobanian et al. (2003) related cardiovascular risk factors to hypertension, abdominal obesity, dyslipidaemia and insulin resistance (metabolic syndrome). The National Cholesterol Education Program (2002) defines the syndrome by the presence of three or more of the five risk factors given below:

Waist circumference: >102 cm for men, >88 cm for women.

Blood pressure: Systolic ≥130 mmHg and/or diastolic ≥85 mmHg.

Fasting glucose: ≥110 mg/dl.

Triglycerides: ≥150 mg/dl.

HDL cholesterol: <40 mg/dl in men, <50 mg/dl in women.

The prevalence of the condition is highly age-dependent and is associated with a 4-fold increase in risk for fatal coronary artery disease and a 2-fold greater risk of fatal cerebrovascular disease.

The report of National Cholesterol Education Program (2002), suggested that the normal total blood cholesterol level should be < 200 mg/dl, borderline cholesterol= 200–239 mg/dl, high cholesterol > 240 mg/dl. The desirable LDL level is considered to be less than 100 mg/dL, although a newer target of < 70 mg/dL can be considered in higher risk individuals.

The cornerstone of treatment is appropriate lifestyle changes but patients with SBP of 140 mm Hg or more or DBP of 90 mm Hg or more and total cholesterol levels of 200 mg/dL or more and/or LDL-C of 130 mg/dL or more are candidates to receive pharmacotherapy (Buitrago et al., 2007).

The response to pharmacological therapy is affected by several factors including the choice of the initial antihypertensive agent, the discomfort of side-effects and poor tolerability of an agent, as well as the change in the drug regimen many times (Cuspidi et al., 2001).

Strategies to control blood pressure must involve the patient, the provider and the health care system. Patients need motivation, support and follow-up as they attempt to learn new skills and change their daily habits. All health care providers including nurses, nutritionists, educators and psychologists are needed to improve patient adherence to lifestyle interventions as well as to treatment recommendations (Chalmers 1992).

Blood pressure control should include the following interventions (Oxman, 1995):

Patient education about hypertension, the potential complications of uncontrolled hypertension, the importance of treatment;

Presenting a simple effective regimen, once-a-day if possible, using a fixed-dose, with the least cost and adverse effects;

Setting a blood pressure goal for the patient; having patients monitor their blood pressure at home;

Scheduled follow-up; discussing new treatment strategies with the patient and involving them in the decision process.

Now, high percentage of health care practitioners recommends specific nutrition and life style change as the

first line of defense to prevent hypertension and to treat mild to moderate high blood pressure (Oxman et al., 1995).

AIM OF THE STUDY

This study was done to investigate the effects of dietary supplementation with Doum (Hyphaene thebaica), as a natural nutrient containing flavonoids, tannins and saponins, on blood pressure, blood lipids and lipoproteins in hypertensive patients.

SUBJECTS & METHODS

PATIENT CHARACTERISTICS

Thirty female patients of Mansoura University Hospitals aged 52.9±5.8, who were hypertensive (systolic= 153.0±7.0 mmHg, diastolic= 94.7±4.0 mmHg), obese (waise circumference = 97.5±6.2), and hyperlipidemic (total cholesterol = 229.2±17.9 mg/dl; triglycerides = 182.5±16.3; low density lipoproteins (LDL) = 160.6±15.1 mg/dl; high density lipoproteins (HDL) = 34.9±5.1 mg/dl; apolipoproteins A-I (apoA-I) = 151.6±5.4 mg/dl; apolipoproteins B (apoB) = 75.3±3.1 mg/dl)

About two thirds (66%) of the sample aged less than 60 years old while only one third (33%) above 60 years old.

Systolic blood pressure ranged from 140-165 mm Hg while diastolic blood pressure ranged from 90-100 mm Hg.

Cholesterol level ranged from 200-240 mg/dl

Low density lipoproteins (LDL) and high density lipoproteins (HDL) ranged from (127 to 183 mg/dl) and (27 to 48 mg/dl) respectively.

Waist circumference was measured because research has shown that waist circumference is directly associated with abdominal fat and can be used in the assessment of obesity or overweight. Persons who carry fat mainly around their waist are more likely to develop obesity-related health problems. Women with a waist measurement of more than 88 cm may have more health risks than people with lower waist measurements because of their body fat distribution (National Cholesterol Education Program, 2002)

Patients were divided into two groups (number = 15 for each group):

Control group: received antihypertensive drug with similar dose.

2. Doum group: received the same antihypertensive drug with the same dose. In addition, they agreed to consume an oral supplement of Doum in a daily dose of 25 mg/kg body weight (Hetta et al., 2005). The ripe Doum fruits were collected from the market. The fruit pulp was left to dry in air at room temperature for 7 days, then grounded (Dosumu et al., 2006).

Blood pressure, plasma lipids and lipoproteins were followed up in all patients for 3 months.

BIOCHEMICAL MEASUREMENTS

Blood samples were obtained after a 12 to 14 h fast.

Concentrations of total cholesterol and triglycerides were measured in EDTA-treated plasma by using enzymatic methods (Menarini Diagnostici, Firenze, Italy).

High density lipoproteins (HDL)-cholesterol concentrations were measured after precipitation of apo B–containing lipoproteins with phosphotungstic acid and magnesium (Roche Diagnostics) by spectroscopy.

Concentrations of apolipoproteins A-I (apoA-I) and apolipoproteins B (apoB) were assessed by immunonephelometry (Dade Behring, Frankfurt, Germany).

Low density lipoproteins (LDL)-cholesterol concentration was calculated according to the Friedewald equation (Friedewald et al., 1972; Sniderman et al., 2003) using levels of other cholesterols:

In mg/dl: LDL cholesterol = total cholesterol – HDL cholesterol – (0.20 × triglycerides)

The basis of this is that total cholesterol is defined as the sum of HDL, LDL, and VLDL. The total cholesterol, HDL, and triglycerides are actually measured. The VLDL is estimated as one-fifth of the triglycerides.

STATISTICAL ANALYSIS

The statistical analyses were performed using the SPSS statistical Package version 12 (SPSS, Chicago, IL, USA). The recorded values were expressed as means and standard deviations (Mean ±SD). The minimal level of significance was identified at $p < 0.05$ (Armitage 1974).

RESULTS

Table (1) and figure (1) showed that at the end of 3 months of the study there was highly significant ($P<0.001$) decrease of systolic and diastolic blood pressure in the Doum group (128.0±6.8 and 79.7±6.4 mmHg) as compared with the

control group (153.0±7.0 and 94.7±4.0 mmHg).

Figure 1

Table 1: Changes of systolic and diastolic blood pressure (mmHg) in control, and Doum groups (n = 15). P = comparison between Doum group at the end of 3 months and control.

	Control	Doum duration			P
		1 month	2 months	3 months	
Systolic pressure (mmHg)	153.0±7.0	142.4±8.1	130.0±9.0	128.0±6.8	<0.001
Diastolic pressure (mmHg)	94.7±4.0	88.6±7.6	81.0±6.9	79.7±6.4	<0.001

Figure 2

Figure 1: Changes of systolic and diastolic blood pressure in control, and Doum groups (n = 15). P = comparison between Doum group at the end of 3 months and control.

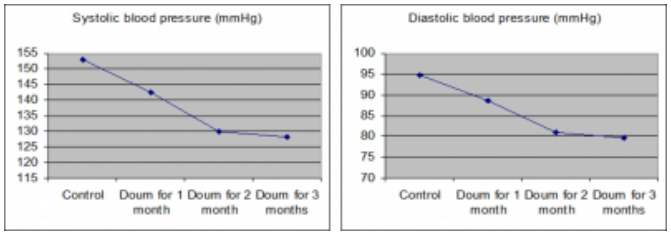


Table (2) and figure (2) showed that at the end of 3 months of the study there was highly significant (P<0.001) decrease of total cholesterol, triglycerides, LDL and apoB in the Doum group (188.5±10.4, 156.7±13.2, 104.0±13.2, and 51.3±2.9 mg/dl respectively) as compared with the control group (229.2±17.9, 182.5±16.3, 158±15.1, and 75.3±3.1 mg/dl respectively).

Figure 3

Table 2: Changes of total cholesterol, triglycerides, LDL, apoB in control, and Doum groups (n = 15). P = comparison between Doum group at the end of 3 months and control.

	Control	Doum duration			P
		1 month	2 months	3 months	
Total cholesterol (mg/dl)	229.2±17.9	214.1±14.2	201.4±12.1	188.5±10.4	<0.001
Triglycerides (mg/dl)	182.5±16.3	170.4±15.8	164.9±15.4	156.7±13.2	<0.001
LDL (mg/dl)	158±15.1	141.2±14.1	119.1±13.5	104.0±13.2	<0.001
apoB (mg/dl)	75.3±3.1	67.1±2.6	58.4±2.8	51.3±2.9	<0.001

Figure 4

Figure 2: Changes of total cholesterol, triglycerides, LDL and apoB in control, and Doum groups (n = 15). Values are mean ± SD. P = comparison between Doum group at the end of 3 months and control.

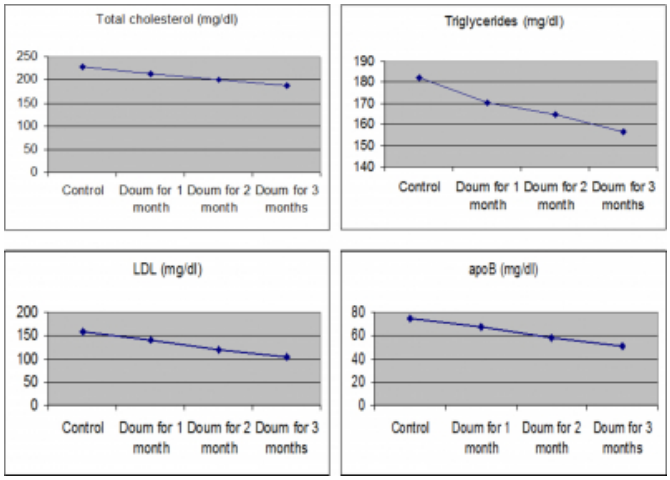


Table (3) and figure (3) showed that at the end of 3 months of the study there was highly significant (P<0.001) increase of apoA-I and HDL in the Doum group (234.1±18.2 and 53.6±4.2 mg/dl respectively) as compared with the control group (151.6±15.4 and 34.9±5.1 mg/dl respectively).

Figure 5

Table 3: Changes of apoA-I (mg/dl), HDL (mg/dl) in control, and Doum groups (n = 15). Values are mean ± SD. P = comparison between Doum group at the end of 3 months and control.

	Control	Doum for 1 month	Doum for 2 months	Doum for 3 months	P
apoA-I	151.6±15.4	173.4±16.6	216.5±17	234.1±18.2	**<0.001**
HDL	**34.9±5.1**	**39.7±4.3**	**49.4±4.1**	**53.6±4.2**	**<0.001**

Figure 6

Figure 3: Changes of apoA-I, HDL in control, and Doum groups (n = 15). Values are mean ± SD. P = comparison between Doum group at the end of 3 months and control.

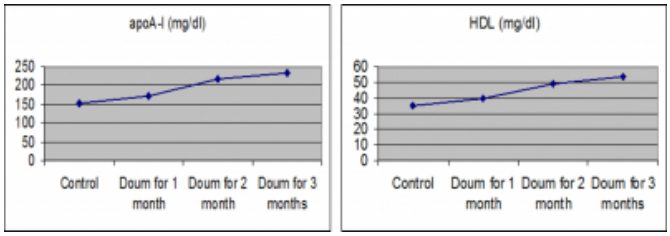


Table (4) and figure (4) showed that at the end of 3 months of the study there was highly significant (P<0.001) decrease

of LDL/HDL ratio in the Doum group (1.96±0.29) as compared with the control group (4.53±0.39).

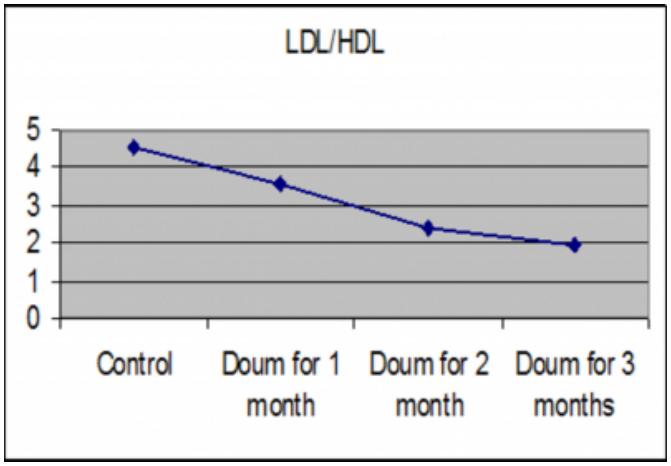
Figure 7

Table 4: Changes of LDL/HDL ratio in control, and Doum groups (n = 15). Values are mean ± SD. P = comparison between Doum group at the end of 3 months and control.

	Control	Doum for 1 month	Doum for 2 months	Doum for 3 months	P
LDL/HDL	**4.53±0.39**	**3.57±0.32**	**2.41±0.31**	**1.96±0.29**	**<0.001**

Figure 8

Figure 4: Changes of LDL/HDL ratio in control, and Doum groups (n = 15). Values are mean ± SD. P = comparison between Doum group at the end of 3 months and control.



DISCUSSION

The use of some plants as medicinal plant is due to the presence of flavonoids (polyphenols) and saponins, hence the use of Doum, which is rich in flavonoids and saponins, in folk medicine is not surprising.

Oral administration of grape flavonoids has been shown to inhibit platelet function (Freedman et al., 2001), and reduce thrombus formation (Demrow et al., 1995). At the vascular wall level, polyphenols exert vasorelaxant effects (Zenebe et al., 2003), inhibit the adhesion of monocytes to the endothelium (Carluccio et al., 2003; Badía et al., 2004), and improve endothelial function (Stein et al., 1997). Finally, polyphenols have been shown to reduce the development of atherosclerosis in animal models (Stocker and O'Halloran 2004; Waddington et al., 2004).

Our results showed that Doum caused a significant decrease in systolic and diastolic blood pressure towards normal values which is consistent with the results of Sharaf et al., (1972) who suggested that the hypotensive action of Doum in rabbits may be due to ganglion blockade.

One of the most striking results of the present study is the improvement of the lipoprotein profile in response to Doum supplementation, with parallel reductions in the concentrations of both LDL and apo B, and increases in HDL and apo A-I, this effect of Doum must be considered as beneficial in the reduction of cardiovascular risk in these patients. In agreement with our results, Kamis et al. (2003) reported a hypolipidemic effect of Doum.

In the human body, high levels of cholesterol, triglycerides, low density lipoprotein (LDL) and oxidized LDL particles in the bloodstream are strongly associated with atheroma formation in the walls of arteries (atherosclerosis), which is the principal cause of cardiovascular diseases and stroke. In contrast, high density lipoprotein (HDL) particles have been identified as a mechanism by which cholesterol can be removed from atheroma. HDL particles transport cholesterol back to the liver for excretion. Increased concentrations of HDL correlate with lower rates of atheroma progressions and even regression. There is a strong inverse relationship between triglyceride level and HDL level. However, the negative impact of raised levels of triglycerides is lower than the ratio between LDL and HDL. (Durrington, 2003).

Our results showed a significant decrease in total cholesterol, triglycerides and LDL. Meanwhile, we found a significant increase in HDL and there was a significant decrease in LDL/HDL ratio. These results could reduce atheroma formation in the walls of arteries (atherosclerosis), thus reducing the risk of cardiovascular diseases and stroke. Moreover, lowering the blood concentration of triglycerides helps to lower the amount of LDL.

These results are beneficial to these patients because they are consistent with the report of National Cholesterol Education Program (2002), which suggested that the normal total blood cholesterol level should be < 200 mg/dl, and the desirable LDL level is considered to be less than 100 mg/dL, although a newer target of < 70 mg/dL can be considered in higher risk individuals.

Also, in men without cardiovascular disease there is a benefit from lowering abnormally high cholesterol levels (Spate-Douglas and Keyser, 1999) and it has been extensively demonstrated in clinical trials that treatment of dyslipidemic patients with drugs that decrease LDL cholesterol levels significantly reduces the risk for coronary heart disease (Nabel 2003; Cantos and Iskandrian, 2003).

LDL appears to be harmless until oxidized by free radicals (Teissedre etal., 1996). LDL poses a risk for cardiovascular disease when it invades the endothelium and becomes oxidized, since the oxidized form is more easily retained by the arterial proteoglycans starting the formation of atheromatous plaques. A complex set of biochemical reactions regulates the oxidation of LDL, chiefly stimulated by presence of free radicals in the endothelium (Cromwell and Otvos, 2004; O'Keefe et al., 2004).

It is postulated that ingesting antioxidants and minimizing free radicals may reduce the contribution of LDL to atherosclerosis (Esterbauer et al., 1991). Doum contains tannins, flavonoids, and saponins which are antioxidants and play an important role in scavengering free radicals (Bhattacharya et al., 2000 and Scartezzini et al., 2006) so they are helpful to prevent oxidation of LDL decreasing its harmful effects.

Hayek et al. (1997) and Nigdikar et al. (1998) reinforce the physiological relevance of these observations because they found that consumption of polyphenols or catechin, is associated with reduced susceptibility of LDL to oxidation and aggregation

Consistent with these observations, ingestion of polyphenol-rich extracts from either green tea (Maron et al., 2003) or pine bark (Devaraj et al., 2002) have been shown to reduce plasma LDL concentrations in humans. A similar effect was found for red wine polyphenols in hamsters (Auger et al., 2002).

In agreement with our results, polyphenols of red wine (Pal et al., 2003) and green tea (Bursill et al., 2001) increase LDL-receptor expression in a human hepatocyte cell line in culture. In addition, they interfere with solubilization of cholesterol in the digestive tract of rats, thereby reducing cholesterol absorption (Raederstorff et al., 2003). In women, they attenuate postprandial chylomicron concentrations, possibly by delaying intestinal absorption of fat (Pal et al., 2004). Also, saponins, can interfere with dietary fat assimilation, (Waterhouse 2003). Therefore, both the inhibition of intestinal absorption of cholesterol and the accelerated clearance of plasma LDL may account for the observed hypolipidemic action of Doum.

Our results about the changes in LDL and HDL and their ratio are very important because data from the Framingham Heart Study (Anderson et al., 1987) showed that for a given level of LDL, the risk of heart disease increases 10-fold as the HDL varies from high to low. While, for a fixed level of HDL, the risk increases 3-fold as LDL varies from low to high. They have shown that high concentrations of HDL (over 60 mg/dL) have protective value against cardiovascular diseases such as ischemic stroke and myocardial infarction. Low concentrations of HDL (below 40 mg/dl for men, below 50 mg/dl for women) are a positive risk factor for these atherosclerotic diseases.

On the contrary, prospective studies found an association between high levels of HDL cholesterol and increased risk of cardiovascular disease, casting doubt on the cardioprotective role of HDL (Chapman et al., 2004).

Our results showed a concomitent increase in both HDL and ApoA-I. this is supported by Lahoz et al. (2003) who suggested that treatments may cause an increase in HDL levels by inducing ApoA-I production.

ApoA-I is a major protein component of HDL in plasma that helps to clear cholesterol from arteries and promotes cholesterol efflux from tissues to the liver for excretion (Dastani et al., 2006). Defects in the gene encoding it are associated with HDL deficiencies (Yui et al., 1988). A type of ApoA-I has also been shown to have a statistically significant effect in reducing (reversing) plaque build-up on arterial walls (Chiesa and Sirtori, 2003).

ApoB on the LDL particle acts as a ligand for LDL receptors in various cells throughout the body. High levels of ApoB can lead to plaques (atherosclerosis) that cause heart disease. There is considerable evidence that levels of ApoB are a better indicator of heart disease risk than total cholesterol or LDL. However, for practical reasons, cholesterol, and more specifically, LDL-cholesterol, remains the primary lipid target and risk factor for atherosclerosis. Overexpression of mApoB have increased levels of LDL and decreased levels of HDL (Pal et al., 2003) explaining our results which showed a parallel decrease in ApoB and LDL with an increase in both HDL and ApoA-I.

CONCLUSION AND RECOMMENDATIONS

In conclusion, dietary supplementation with Doum exerts hypotensive and hypolipidemic effects.

However, further work should be done to determine whether it is the flavonoids content that account for the protective effects of Doum or due to other mechanisms.

An effective reduction of circulating lipids can be obtained using combination of hypolipidemic agents with other lipid-

modifying drugs.

Reduce weight, salt intake, and improve dietary habits while increasing exercise to improve health in those with risk factors for hypertension-associated conditions.

Recommendations for dietary and activity changes are dependent on the provider's confidence in his/her ability to teach patients the necessary skills, their importance, potential benefits and the amount of time available for preventive services.

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