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Hypolipidemic effects of *Coriandrumsativum* Leaves extract on a diet- induced hyperlipidemia in mice

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Abstract
Coriandrumsativum (Coriander) has been recognized as a traditional treatment for hyperlipidemia and diabetes. The present study was designed to investigate the effects of aqueous extract of *Coriand rumsativum* leaves on lipid profile in a diet-hypercholesterolemic mice. The subjects were randomized into 3 groups: Group A (Normal Control); Group B (Hypercholesterolemic Control); Group C (Hypercholesterolemic + *Coriandrumsativum* treated). Hyperlipidemia was induced by feeding high fat diet. After 3 weeks of hypercholesterolemic diet, body weights, blood cholesterol level, triglycerides, Plasma enzyme ALT, AST and ALP levels were measured. The oral administration of aqueous extract of *Coriandrumsativum* leaves showed reduction in total cholesterol, triglycerides and serum enzyme ALT, AST and ALP levels in hypercholesterolemic mic compared to normal group. The findings of this study indicated that the administration of *Coriandrumsativum* improved level of lipid profile and decreased in the serum enzyme ALT, AST and ALP levels in hypercholesterolemic mice.

Keywords. *Coriandrumsativum, Blood Cholesterol level, triglycerides, Serum enzymes, Hypercholesterolemia*

Introduction

Hyperlipidemia characterized by increased levels of cholesterol and triglycerides in the blood and plays an important role in the coronary heart disease development. Hyperlipidemiais one of the principal causes of death in the developed countries such as libya. Therefore, searching for more effective and safer hypolipidemic drug has been continued to be an important area of active research. Various medical plants were used for preparation of food in different countries also used to treat diabetes and Hyperlipidemia. The effect of these plants like garlic and onion have been known for a long time, a number of researches on the antilipidemic effect of these plants, essential oils and their derivatives have been reported. Thus, *Coriandrum sativum* (*Coriander*) which widely used as a spice can be used as a medical plant. *Coriander* have been studied and reported as antidiabetic **(Gray and Flatt, 1999),** anti-inflammatory and has an inhibitory effect

on cholesterol levels **(Chithraand Leelamma, 1999; La *et al.,* 2004 and Dhanapakiam *et al.,* 2008).** Moreover, the antioxidant profile of *Coriander* in various studies has been published. The methanol extracts and aqueous leaf extracts, leaf essential oil, leaf petroleum ether, ethyl acetate and chloroform extracts of *Coriander* exhibited due to its high total phenolic content lipoxygenase inhibition, phospholipid peroxidation inhibition, 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activity, iron chelating activity, hydroxyl radical scavenging activity, glutathione reduction and antlipid peroxidation **(Wangensteen *et al.,* 2004; Melo *et al.,* 2005; Wong and Kitts, 2006 and Reddy *et al.,* 2012)**. On the other hand, **Xin-Zhi *et al.,* (2012**) indicated that, the *Coriander* water extract had very strong inhibition on *E. coli* and *Bacillus subtilis*, thus, as a result the *Coriander* water extract had better inhibitory effect to the gram-negative bacteria. Besides, *Coriander* seeds showed significant hypoglycemic action on alloxan induced diabetic rats **(Sreelatha and Inbavalli, 2012)**and on streptozotocin–induced diabetes mice **(Gray and Flatt, 1999).** Consequently, for more Clarification to the therapeutic effect of *Coriander* on Hyperlipidemia, the objective of this study was todetermine the effect of the coriander on Hyperlipidemia by using aqueous extractin adiet-induced hyperlipidemic mice.

Materials and Methods

***Extraction of Plant material*:**

Coriandrum sativum leaves were collected from local market at Albeida-Libya. They were washed with distilled water. Aqueous Extract of *Coriandrum sativum* leaves was prepared by boiling 20 gram of *Coriander* leaves in 100 ml of distilled water in 250 ml conical flask, then soaked for 1hr. After cooling, the contents of flasks were filtered and stored at 4°C.

Experimental animals:

Total 21 mixed albino mice, aged between 5 to 6 weeks and weighing between 25 to 30g were collected from small animal house of Faculty of Vetrinary Medicine- Omar Almukhtar University, Albeida-Libya. The mice were divided into 3 groups: group-A which kept as normal control group was fed on standard diet only; group-B was fed on standard diet with 30 % animal fat for 3 weeks to be Hyperlipidemia and group-C was fed on standard diet with 30 % animal fat and treated using single dose [10µl] of aqueous extract of *Coriander* leaves every day through oral administration for 3 weeks.

Collection of Samples:

The mice were sacrificed at the end of the experiment (3 weeks). The collected blood samples were kept about 10 min at room temperature. After centrifugation at 3000 r.p.m for 15 min using thermo scientific centrifuge, serum was placed in 1.5 ml Eppendorf tube and kept at -20°C until analysis.

Biochemical analysis:

The Serum total cholesterol was measured by-Hitachi-902 fully automated Chemistry analyzer by Roche diagnostics **(Siedel *et al.,* 1983)** and triglycerides was measured by Hitachi-902 fully automated Chemistry analyzer by Roche diagnostics **(Shephard and Whiting, 1990)**.

The serum enzyme like alanineaminotransferase (ALT) by Hitachi-902 fully automated Chemistry analyzer by Roche diagnostics **(Bergmeyer *et al*., 1986b),** aspartateaminotransferase (AST) by Hitachi-902 fully automated Chemistry analyzer by Roche diagnostics (**Bergmeyer *et al*., 1986a)** and alkaline phosphatase (ALP) levels was measuredbyHitachi-902 fully automated Chemistry analyzer by Roche diagnostics **(Shaw *et al.,* 1983).**

Statistical analysis:

The data are expressed as Mean ± SEM. The results of the study was analyzed using one-way ANOVA followed by Tukey test (SPSS version19). To discriminate among means the *F-test* was applied. The level of significance was $P \leq 0.05$, $P \leq 0.001$ and $P \leq 0.0001$.

Results

After 3 weeks of hypercholesterolemic diet the effect of *Coriander* leaves on body weights, total cholesterol level, triglycerides and serum enzymes ALT, AST and ALP levels in group A, B and C were measured.

3.1.Effect of aqueous extract of Coriandrum sativum leaves on changes of body weight (gr) in normal and hypercholesterolemic mice.

There was significant increase in the body weights of hypercholesterolemic mice compared to normal group. In contrast, there was significant loss in the body weight of hypercholesterolemic mice that were treated with aqueous extract of *Coriander* leaves when compared to untreated hypercholesterolemic mice.

Table (1). Effect of aqueous extract of *Coriander* leaves on changes of body weight (gr) in normal and hypercholesterolemic mice

	Sum of Squares	df	Mean Square	F	Sig. (P)
Between Groups	33.429	2	16.714	10.125	.001
Within Groups	29.714	18	1.651		
Total	63.143	20			

Groups	control group	hypercholesterolemic	hypercholesterolemic + *Coriander*
Body weight (gm)	24.28 ± 0.35*	27.28±0.60 **	25.14± 0.45 *

The mean difference is significant at P≤0.05 .
* , **, *** insignificant difference between similar letters.

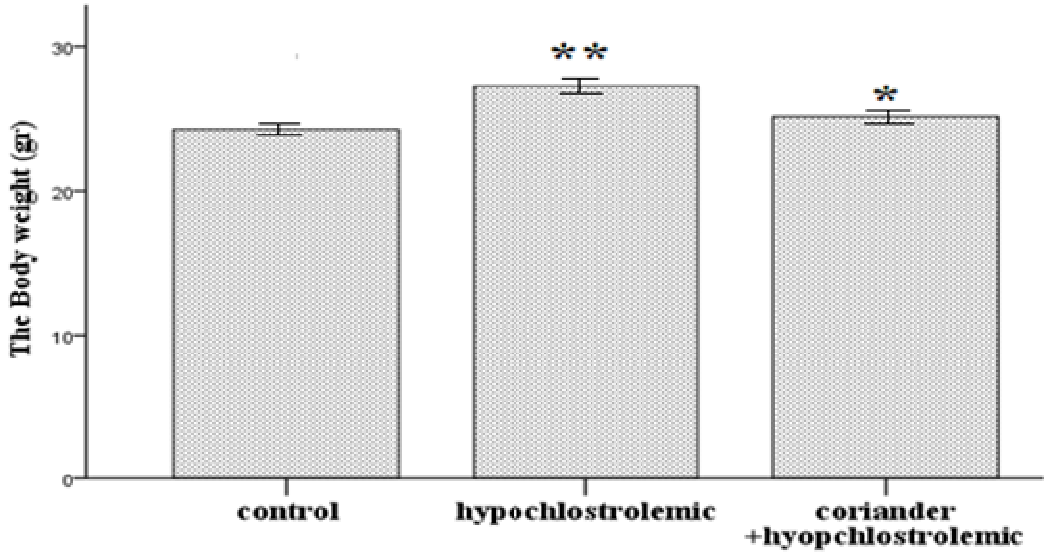

Figure (1). Effect of aqueous extract of *Coriander* leaves on changes of body weight (gr) in normal and hypercholesterolemic mice.
*(P)≤0.05,
**(P)≤0.001.

3.2. Effect of aqueous extract of Coriander-leaves on total cholesterol level (mg/ dl) and triglycerides (mg/ dl) in normal and hyper-cholesterolemic mice.

Table 2 and 3; Fig2 and 3showed the levels of total cholesterol and triglycerides in normal and hypercholesterolemic mice. There was a significant increase in the level of serum cholesterol and triglycerides in hypercholesterolemic mice compared to normal mice. The treatment of the hypercholesterolemic mice with the aqueous extract of *Coriander* leaves every day for 3 weeks significant reduced the levels of total cholesterol and triglycerides when compared to untreated group.

Table (2). Effect of aqueous extract of *Coriander* leaves on total cholesterol level (mg/ dl) in normal and hypercholesterolemic mice

	Sum of Squares	df	Mean Square	F	Sig.(P)
Between Groups	27378.000	2	13689.000	12.834	.0001
Within Groups	19199.143	18	1066.619		
Total	46577.143	20			

The mean difference is significant at P≤0.05 .
* , **, *** insignificant difference between similar letters.

Table (3). Effect of aqueous extract of *Coriander* leaves on triglycerides level (mg/ dl) in normal and hyper-cholesterolemic mice.

	Sum of Squares	df	Mean Square	F	Sig. (P)
Between Groups	3877.810	2	1938.905	14.487	.0001
Within Groups	2409.143	18	133.841		
Total	6286.952	20			

	Control group	Hypercholesterolemic	Hypercholesterolemic + *Coriander*
Total cholesterol (mg/ dl)	165.28 ± 1.5*	251.42 ± 9.3**	191.0 ± 19.1*
Triglycerides (mg/ dl)	90.28 ± 1.8	123.71 ± 6.2 **	107.8 ± 3.8*

The mean difference is significant at P≤0.05 .
* , **, insignificant difference between similar letters.

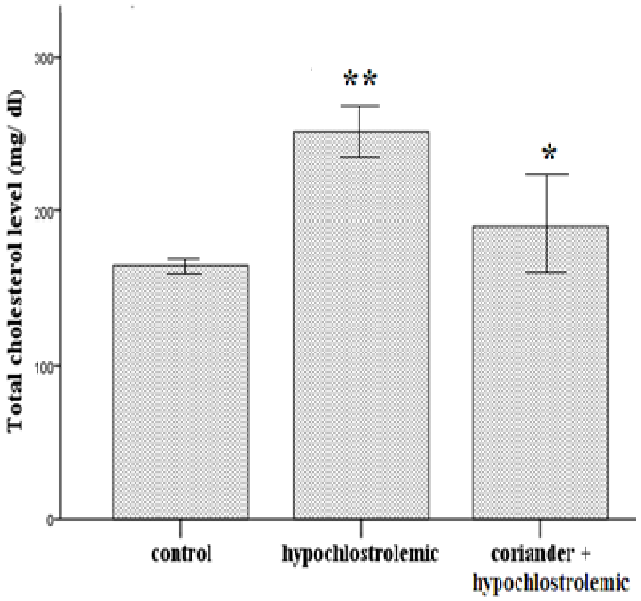

Figure (2). Effect of aqueous extract of *Coriander* leaves leave on total cholesterol level (mg/ dl) in normal and hypercholesterolemic mice
*(P) ≤ 0.05 *(P) ≤ 0.05. **(P)≤ 0.0001.. **(P)≤ 0.0001

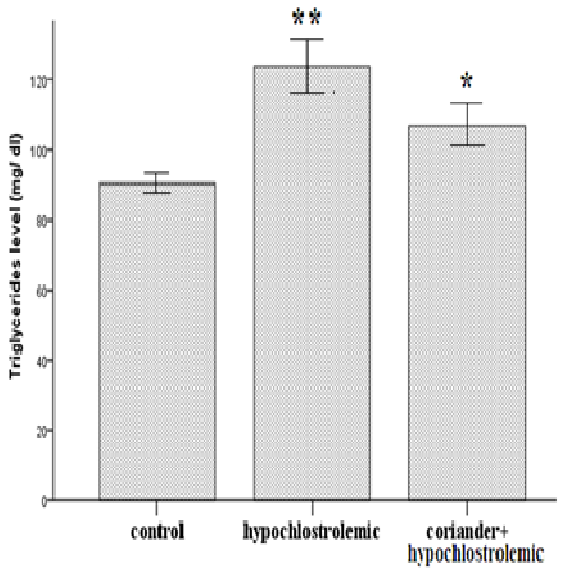

Figure (3). Effect of aqueous extract of *Coriander* on-triglycerides level (mg/ dl) in normal and in normal and hypercholesterolemic mice hypercholesterolemic mice.
*(P) ≤ 0.05 *(P) ≤ 0.05. **(P)≤ 0.0001.. **(P)≤ 0.0001.

3.3.Effect of aqueous extract of Coriander leaves on serum enzymes AST, ALT and ALP levels (U/L) in normal and hypercholesterolemic mice.

Our results indicated significant effect in levels of AST, ALT and ALP enzymes in hypercholesterolemic group compared to normal control. Oral administration of aqueous extract of *Coriander* leavesin hypercholesterolemic mice significantly restored the enzyme levels to near normal (Table 4,5 and 6; Fig 4.5 and6).

Table (4). Effect of aqueous extract of *Coriander* leaves on serum enzymes AST level (U/L) in normal and hypercholesterolemic mice.

	Sum of Squares	df	Mean Square	F	Sig. (P)
Between Groups	37502.952	2	18751.476	28.797	.0001
Within Groups	11720.857	18	651.159		
Total	49223.810	20			

Table (5). Effect of aqueous extract of *Coriander* leaves on serum enzymes ALT level (U/L) in normal and hypercholesterolemic mice.

	Sum of Squares	df	Mean Square	F	Sig. (P)
Between Groups	774.095	2	387.048	7.045	.005
Within Groups	988.857	18	54.937		
Total	1762.952	20			

Table (6). Effect of aqueous extract of *Coriander* leaves on serum enzymes ALP level (U/L) in normal and hypercholesterolemic mice**.**

	Sum of Squares	df	Mean Square	F	Sig.(P)
Between Groups	3304.667	2	1652.333	42.733	.0001
Within Groups	696.000	18	38.667		
Total	4000.667	20			

	control group	hypercholesterolemic	hypercholesterolemi + *Coriander*
AST(U/L)	331.28 ± 5.6	424.71 ± 12.9 **	342.85 ± 9.1**
ALT(U/L)	81.85 ± 3.5	95.28 ± 2.7 *	88.42 ± 3.0*
ALP(U/L)	114.57 ± 1.5	145.28 ± 2.0 **	129.14 ± 3.1**

The mean difference is significant at P≤0.05 .
* , **, insignificant difference between similar letters.

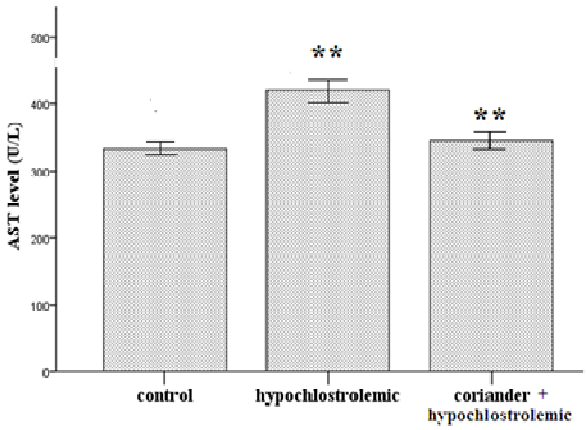

Figure (4). Effect of aqueous extract of *Coriander* leaves on AST enzyme (U/L) in normal and hypercholesterolemic mice.
*(P) ≤ 0.05.**(P) ≤ 0.0001

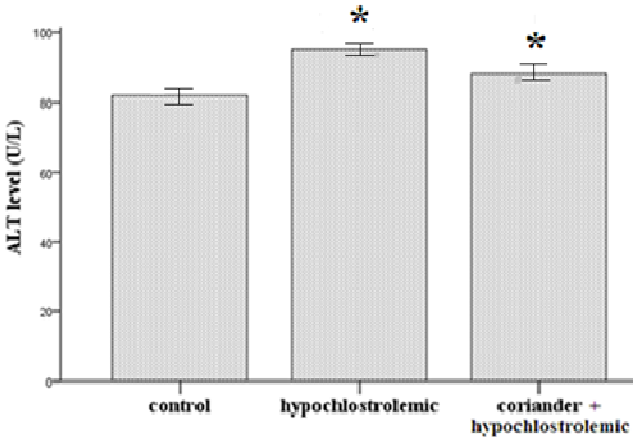

Figure (5). Effect of aqueous extract of *Coriander* leaves on ALT level enzyme (U/L) in normal and hypercholesterolemic mice.
*(P) ≤ 0.05.**(P) ≤ 0.0001.

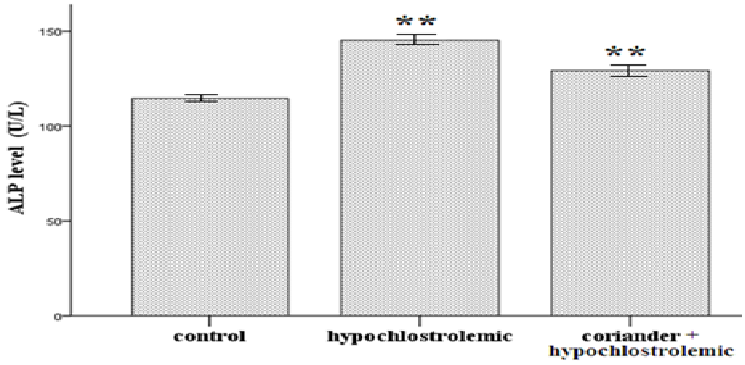

Figure (6). Effect of aqueous extract of *Coriander* leaves on ALP level enzyme (U/L) in normal And hypochlostrolemic mice.**(P) ≤ 0.0001

Discussion

This experimental study was conducted to evaluate the antilipidemic effect of *Corianderumsativum (Coriander)* leaves by using aqueous extract in a diet- induced hyperlipidemia in mice. Our results showed that the body weight of the mice fed with a high-fat diet was significantly higher than normal group. The rise in the body weight of the untreated hypercholesterolemic mice could be because of the increasing in the total serum cholesterol and free fatty acids in the tissue. **(Mogill and Mott, 1976)**. **Eisinger *et al.,* (2014**) shows in fat fed mice that theanimals gain more weight, have increased fasting glucose and total cholesterol. **Blaak *et al.,* (1994)** indicate that eating of high-fat diets, would be the main reason of deposition of dietary fat into the fat stores. The body weight gain of hypercholesterolemic mice was obviously blocked by the oral administration of aqueous extract of *Coriander* leaves for 21 days. These results suggested that the *Coriander* has antioxidant and antilipidemic activity. The ant oxidative property of *Coriander* extract may be linked to the large amounts of carotenoids, tocopherols and phospholipids **(Ramadan and Mörsel, 2002)**. Moreover, **Joshi *et al.,* (2012)** has noted less cholesterol deposits in the aorta of high cholesterol diet rabbits after administration of 70% methanolic extract of *Coriander,* while the faecal excretion of cholesterol and phospholipids was increased compared to the high cholesterol diet untreated animals. In addition, some experiments in rats and rabbits indicated that the antioxidant effect of *Coriander* was due to an increase in glutathione (GSH) and catalase activity and reduction in hepatic lipid per oxidation **(Chithra and Leelamma, 1999** and **Joshi *et al.,* 2012)**. In our results, The hypolipidemic action of aqueous extract of *Coriander* leaves was observed through significant reduced levels of total cholesterol and triglycerides of the tretmenthypercholesterolemic mice. Various studies indicate that the *Coriander* decreased the serum total cholesterol, triglyceride, LDL-cholesterol, VLDL-cholesterol levels and increased the level of HDL-cholesterol. (**Chithra and Leelamma, 1997; La *et al.,* 2004; Dhanapakiam *et al.,* 2008; Kansal *et al.,* 2011** and **Joshi *et al.,* 2012**). **Lin *et al.,* (2004)** reported that the cholesterol-lowering effect of *Coriander* is probably due to enhanced removal of LDL-cholesterol from plasma by increasing LDL-receptor activity. The decrease in serum triglyceride after the administration of aqueous extract of *Coriander leaves* coud be because the activity of lipoprotein lipase (LPL) (**Anderson, 2003)**. Moreover, the inhibition in the levels of serum cholesterol and triglyceride in rats fed cholesterol diet after administration of *Coriander* seeds powder may be due to increased the HMG CoA reductase, a microsomal enzyme, Becusethes enzyme involved in the cholesterol biosynthesis in liver (**Dhanapakiam *et al.,* 2008**). It is clear from the results that consumption of high fat diet in mice for 21 days showed a significant increase in some biochemical parameters which include AST, ALT and ALP enzymes. These enzymes are very important indicator of the liver function and integrity (**Adaramoye *et al.,* 2008**).

AST, ALT and ALP enzymes are usually increased in acute hepatotoxicity but they tend to reduce with prolonged intoxication due to damage to the liver (**Eisinger *et al.,* 2014**). Another study has been reported that in asymptomatic individuals with higher levels of ALT and AST enzymes 98% has liver disease commonly fatty liver disease (**Hultcrantz *et al.*, 1986**). The present results are in accordance with the study of **Han *et al.,* (2012),** they reported elevated determinants of liver function tests with hyperlipidemia. As demonstrated in table (4,5 and 6) that the levels of AST, ALT and ALP enzymes in hypercholesterolemic group were significantly reduced by administration of aqueous *Coriander* extract comparison to control mice. *Coriander* extract may play an essential role in modulating redox status and oxidative stress in the liver **(Hayat, 2009**). Oxidative stress was manifested by a significant increase in nitric oxide (NO), thiobarbituric acid reactive substance (TBARS) levels and myloperoxidase (MPO) activities in the liver tissues. **Chithra and Leelamma,**

(1999) have been published that *Coriander* changes the activity of antioxidant enzymes in rats administered high fat diet. Rats fed with *Coriander* leaves and seeds showed a decrease in the serum ALT, AST and ALP activities and in the liver NO and TBARS levels (**Lopez and Pascual, 2008**). Oral administration of *Coriander* seed powder in diabetic rats not only inhibited the process of per oxidative damage but also significantly reactivated the antioxidant enzymes and antioxidant levels (**Deepa and Anuradha, 2011**). Our experiment data are in quite agreement with those of **kansal *et al.*, (2011); Suresh *et al.*, (2012) and Hasan and Belal, (2015).**

Conclusion

In conclusion our study demonstrated that oral administration of *Coriandrumsativum* extract for 3 weeks may be had ameliorating effects on the hyperlipidemia. The total cholesterol, triglycerides and some biochemical variables were reversed by treatment with this plant extracts

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