International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG(USA) Volume 5, Issue 6 - 2018

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2018.05.06.013

The Modulatory Role of Artichoke leaves Water Extract on Lipid Status on Rats Fed High Fat Diet

Majd M.Abdulkhaleq[1*], Hanan S. Alnahdi[2], Rasha H.Hussein[1]
[1]Department of Applied Biochemistry, Faculty of Science-Al Faisaliah Campus, King Abdulaziz University, Jeddah- Saudi Arabia.
[2] Department of Applied Biochemistry, Faculty of Science, Jeddah University, Jeddah, Saudi Arabia.
*Corresponding author: *maj0o0da@hotmail.com*

Abstract

High fat diet HFD induces excessive body fat content and lipid abnormalities. The importance of using medicinal plants becomes more patent in the present time Artichoke is a plant that traditionally used for treatment of different disease. The study aimed to investigate the role of supplementing low or high doses of water extract of artichoke leaves in rats fed HFD. For this purpose, four rat groups were established as follow: control group, high fat diet group, Low dose artichoke+ HFD group treated by low dose of artichoke extract(600 mg /kg b.w/day) after three weeks following obesity induction, and high dose artichoke +HFD rats was treated by high dose of artichoke extract(1500 mg /kg b.w /day). Body weight gain, serum lipid parameters, liver enzymes and liver histological status were examined. Results showed that HFD increased body weight, lipid parameters and causes abnormal liver enzyme levels along with fat droplets accumulation between liver cells. These parameters were counteracted by supplementing either low or high dose of artichoke extract, indicating the mitigating effect of artichoke against HFD side effects. It was noticed that the hypolipodemic and antiatherogenic effect was more observable in low dose of extract than that of high dose.

Keywords: Artichoke - high fat diet – obesity- water extract

Introduction

Obesity and overweight as a consequence of high-fat diet (HFD), is a multifactorial disease. Includes an increased mass of adipose tissue that may lead to hypertension **(Klop, 2013)** and cardiovascular diseases **(London, 2007 and Fantuzzi, 2005)**. Furthermore, obesity has hazardous effects on liver and antioxidant enzyme. Different studies showed that the increase in intracellular reactive oxygen species, which induces oxidative stress, is associated with high fat diet and fat accumulation **(Bakos et al, 2011 and Roushandeh et al., 2015)**

It is a typical supposition that medicinal plants which contain full of flavonoids and phenolics can protect against receptive oxygen species (ROS)**(Dianita et al, 2016)**. Artichoke (*Cynara scolymus* L.) is a plant that grown in Mediterranean countries and rich in the bioactive compounds such as caffeoylquinic acid derivatives (cynarin and chlorogenic acid) and flavonoids (luteolin, apigenin) natural antioxidants **(Joy and Haber, 2007).** The artichoke leaf extract has been has hepatoprotective and cholesterol reducing properties. Studies show that artichoke extract is very effective as an antioxidant and its health-protective potential has been attributed to its antioxidant power and property to decrease the production of reactive oxygen species **(Lupattelli et al., 2004).** Polyphenolic compounds presented mainly in the leaves rather than in the artichoke heads have been documented as the active principles of this plant **(Bonomi, 2001).** (**Zapolska-Downar et al., 2002)**.

Materials and Methods

Plant extract

For this experiment, artichoke leaf extract was obtained from Now Foods Company, USA. The extract was dissolved in water, prepared as high dose and low dose for rat treatments.

Experimental animals and diet

Forty male albino rats weighing 250-260 g, obtained from King Fahd Medical Research Center, Jeddah. The rats were housed at King Fahd Medical Research Center Animal Facility Breeding Colony and kept at constant temperature (25°C) under controlled conditions of light/dark cycle at. During acclimatization period, rats were free accessed to water and standard laboratory diet. Experiment was approved by the Ethical Committee of King Fahd Medical Research Center, Jeddah, KSA.

Preparation of high fat diet (HFD)

High-fat diet (containing 45 % vegetable margarine) was prepared by mixing with standard pellets with vegetable margarine.

Animal groups and Treatments

Animals were divided as following:

(1) Healthy control group

(2) High fat Diet obese rats: (HFD) obesity was induced by feeding rats on high fat diet for 8 weeks and continue feeding HFD for further 3 weeks

(3) Low dose artichoke +HFD: after induction of obesity for 8 weeks, rats received artichoke water extract (low dose, 600 mg /kg body weight /day) in distilled water orally by gavage for 3 weeks.

(4) High dose artichoke +HFD: after induction of obesity for 8 weeks, rats received artichoke water extract (high dose, 1500 mg /kg body weight /day) in distilled water orally by gavage for 3 weeks.

Body weight gain was calculated from the difference between the initial weight at the beginning and the final weight at the end of the experiment.

Sample collection:

At the end of the experimental period (after 11 weeks), animals were fasted overnight and scarified under ether anesthesia , blood samples were collected from hepatic portal vein to be centrifuged. Blood samples were left for 30 minutes at temperature of 25°C in order to separate serum. Rat organs (liver, kidney, heart) were immediately removed, rinsed with ice cold saline, blotted dry, weighed separately and the relative weight were calculated.

Biochemical Analysis

Serum total lipids (TL), Serum level of total cholesterol (TC), total triglycerides (TG) and high-density lipoprotein-cholesterol (HDL) were determined by commercial kits (Crescent Diagnostic. KSA). While, Serum very low density lipoprotein (vLDL) was determined according to **Norbert (1995)** formula: VLDL = TG/5. Meanwhile, calculation of serum LDL-Cholesterol fraction concentration was determined according to **Friedewald et al. (1972)** formula. The Atherogenic index (AI) was calculated by formula of **Harnafi et al., (2008)** Serum alanine transaminase (ALT) and aspartate transaminase (AST) activities were determined by commercial kits (Crescent Diagnostic, KSA).

Histopathological analysis

The liver tissues from right ventral lobe were fixed in 10% buffered formaldehyde, embedded in paraffin, sectioned and mounted in slides then according to standard hematoxylineosin protocols.

Statistical analysis

Data were statistically analyzed by SPSS version 20.0 statistical packages using one way ANOVA. The results were expressed as means ± SD Differences considered significant when $p<0.05$

Results

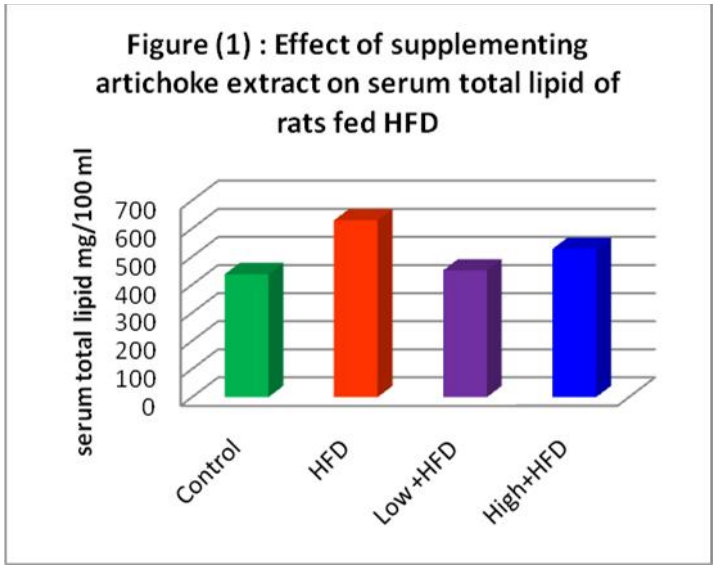
Biochemical Findings:

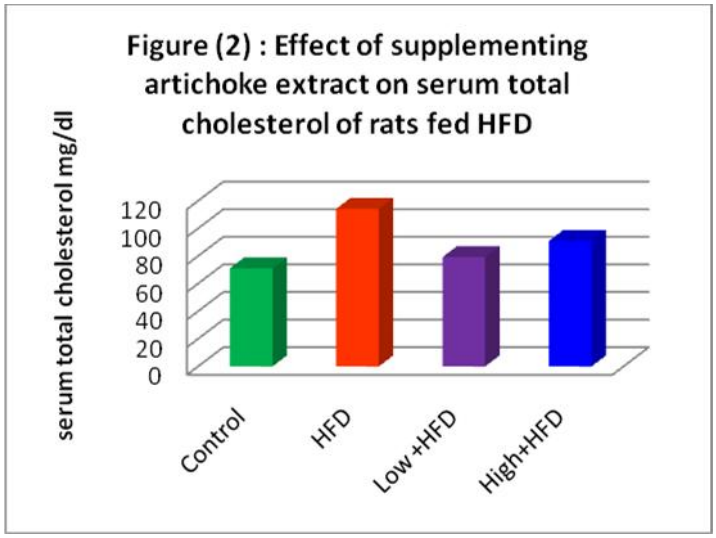
Table (1) Effect of supplementing artichoke extract on relative organs weight and body weight gain of all experimental groups.

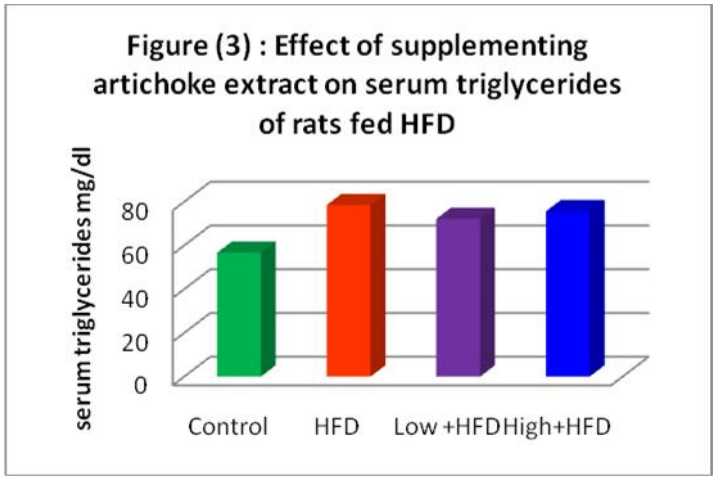
Groups	Body weight gain (g)	liver	Heart	Kidney
control	110.7±4.2 [a]	3.54±0.47[a]	0.401±0.02[a]	0.49[a]
High fat diet (HFD)	212.7±3.4[ab]	3.92±0.41[b]	0.485±0.3[ab]	0.54[ab]
Low dose +HFD	186±4.9 [abc]	3.41±0.62[b]	0.389±0.3[ab]	0.51[abc]
High dose +HFD	196.3±4.1[abc]	3.47±0.44[b]	0.394±0.29[ab]	0.54[c]

The data are expressed as mean ± S.D

Table (1) showed that high fat diet induced a significant (p<0.05) increase in body weight causing the induction of obesity after 9 weeks of treatment similarly, there was a significant increase (p<0.05) in relative weight of organs (liver, kidney and heart) of HFD fed rats as compared to control rats. While treatment by artichoke water extract either high or low dose, reduced body weight gain and organs relative body weight.







The obtained results of this study showed that feeding high fat diet increased lipid parameters significantly as compared to control group. **Figures (1,2,3)** revealed that treatment with either low dose or high dose of artichoke water extract reduced total lipids , total cholesterol and triglycerides in rats fed HFD. Total lipid content of (low dose+HFD) group, showed no significant (p<0.05)deference when compared to control group, meaning that total lipid results of low dose group was restored to be near healthy control one. Same results obtained for TG level that artichoke extract treatment reduced the level when compared to HFD group. As seen in**Figures (4, 5, 6),** feeding HFD caused a highly significant (p<0.05) elevation in LDL-c level which was counteracted after artichoke supplementation. Similar results were obtained for HDL-c. For VLDL-c result no significant (p<0.05) difference was observed between (low dose+HFD) and (high dose+HFD) rat treated groups. **Figures (7)** revealed that rats fed HFD exhibited a profound increase in the atherogenic index as compared to normal control while treatment with either low or high dose of artichoke reduced AI significantly (p<0.05)as compared to HFD group.

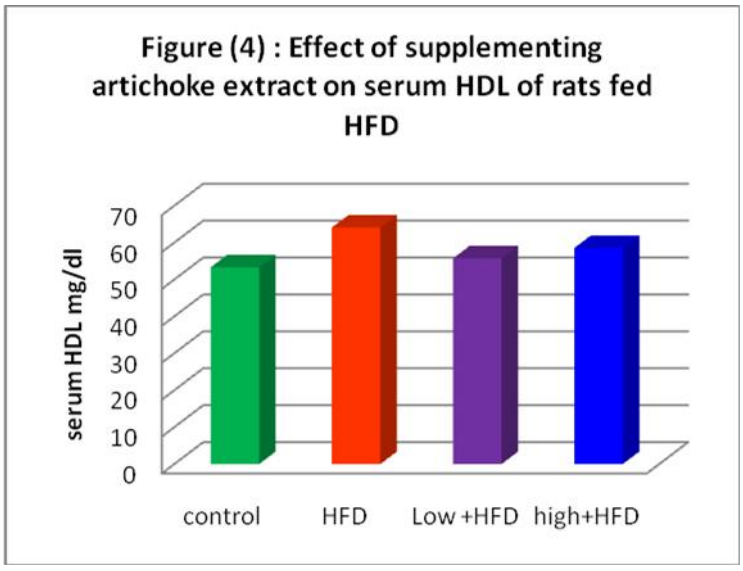


Figure (5) : Effect of supplementing artichoke extract on serum LDL of rats fed HFD

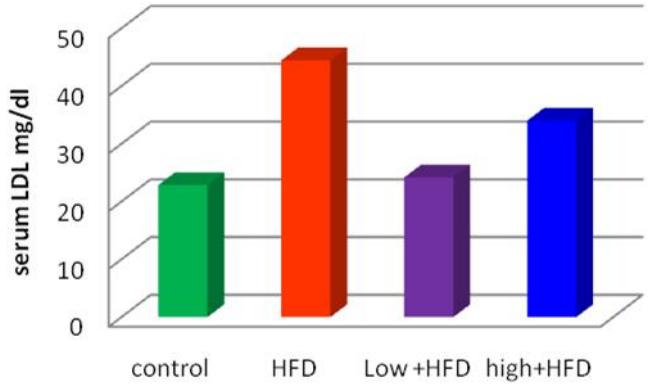


Figure (6) : Effect of supplementing artichoke extract on serum VLDL of rats fed HFD

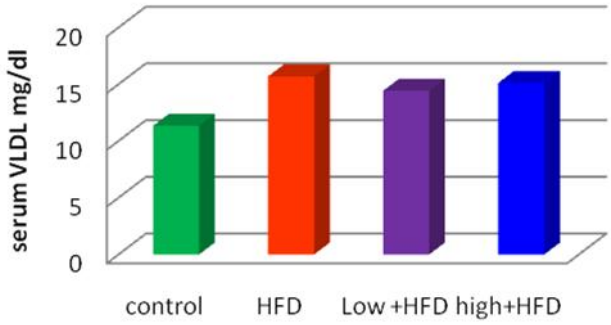
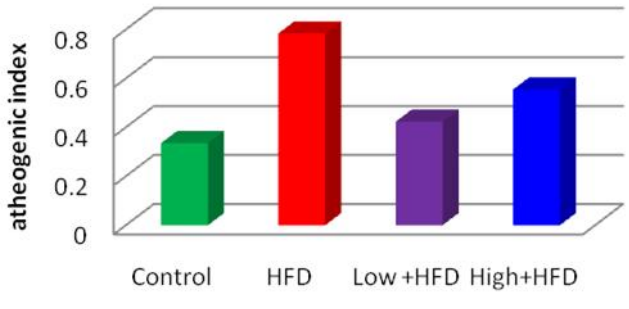
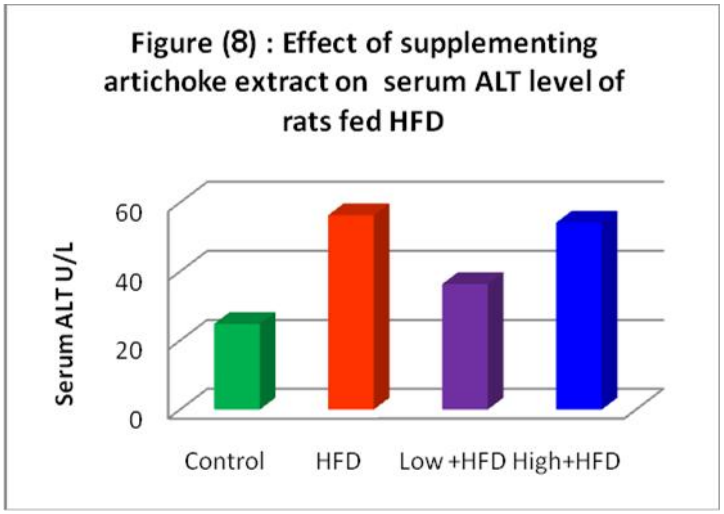
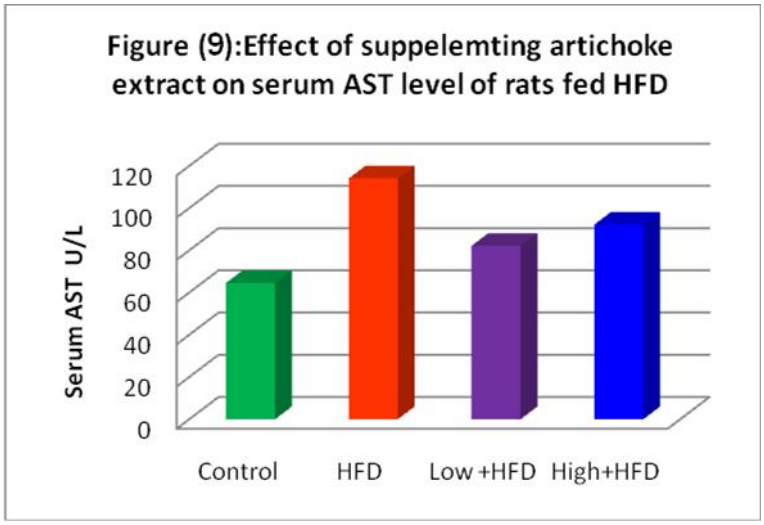


Figure (7):Effect of supplementing artichoke water extract on atherogenic index of rats fed HFD







Figures (8, 9) showed that high fat diet affects both serum ALT and AST as it increase their levels significantly (p<0.05) as compared to control untreated rats. Comparing high and low doses of artichoke water extract showed that low dose effect on reducing liver enzymes was more apparently than that of high dose.

Histopathological findings

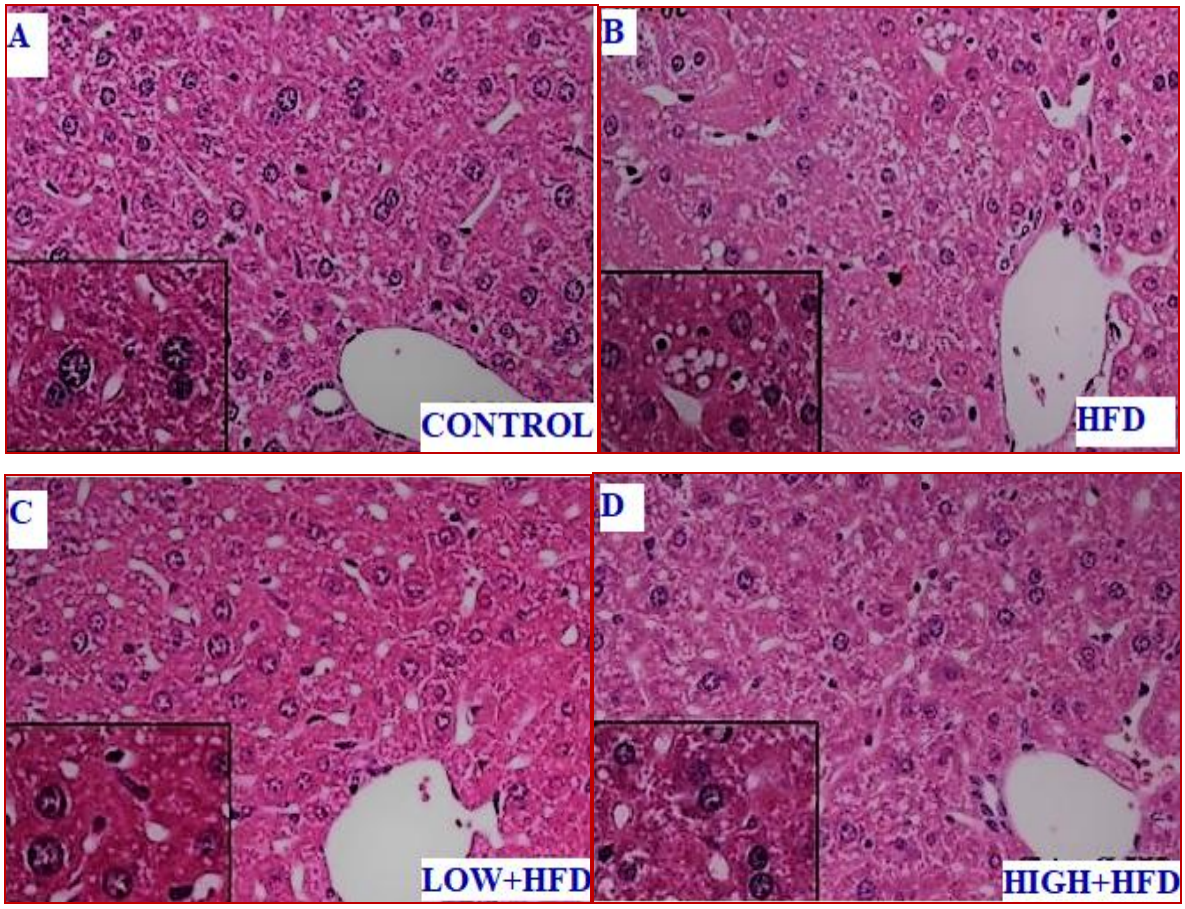


Figure (10) : Histopathological features of liver samples in all experimental groups (A)control group, normal liver cells show that cells in normal arrangement, (B)HFD group show accumulation in fat droplets between liver cells (C) Low+HFD group ,show a reduction in fat droplets between liver cells as compared to HFD group (D) High+HFD group show fat droplets which were slightly lower than low+HFD group.

Discussion

Treatment of hyperlipidemia needs diet control, exercise, and using lipid-lowering compounds such as drugs and diet**(Salem, et al, 2015).**

This study investigated the role of supplementing low and high doses of water extract of artichoke leaves in rats fed HFD by measuring weight gain, lipid parameters, liver enzymes and liver histological status. In this study, artichoke used here purchased as commercial leave extract. Artichoke leaves extract contained bioactive compounds such as cynarin and luteolin glucosides **(Wang et al, 2003)**. **(Liorach et al, 2002).** HFD induced obesity after feeding HFD, the increase in body weight was counteracted in groups fed artichoke water extract using either low or high dose (**Küskü-Kiraz et al., 2010).** Similarly, feeding HFD was accompanied by elevated serum total lipid content, while supplementing low or high doses of artichoke water extract reduces this content. **(Boden G, 2001)**. Fatty acid metabolites accumulate and cause lipotoxicity. For this reason, increased TG level is accompanied by an increase in total cholesterol with a reduction in high-density lipoprotein (HDL-c) (**Schaffer,2003)**. Most of the previous studies on artichoke have shown that artichoke has cholesterol and TG lowering effects **(Shimoda et al., 2003).** The mechanism of reducing cholesterol level by artichoke leave extract was studied by examining the role of the constituent luteolin in the inhibiting effect of artichoke extract on cholesterol synthesis. It inhibits HMG-CoA reductase, the key enzyme of cholesterol biosynthesis and prevents accumulation of undesired sterol compounds.**(Esfandiar & Yadollah, 2011).(Juzyszyn et al., 2008).**

(Gebhardt, 1998).(Wider et al., 2009). Lipid lowering effect was more apparently in low dose of artichoke water extract rather than that of high dose of artichoke extract. The results of the present study were in agreement with a study by **Mocelin, et al (2016)** which showed that using artichoke dose ranging from 600 mg/kg mitigated the elevated values of serum TC and LDL-C levels.

HFD caused a significant increase in serum levels of ALT and AST, this was attributed to the liver injury. **Marchesini et al, (2008)** stated that, Obesity and overweight increased levels of hepatic enzymes alanine aminotransferase (ALT), aspartate aminotransferase (AST) concentration in liver and tissues.**Mehmetçik, et al,(2008)** stated that the antioxidant properties of caffeoylquinic acids present in artichoke were responsible for the hepatoprotective action. **(Speroni et al., 2003).**Histological observations showed that high fat diet markedly affected histopathological structure of hepatic cells by causing remarkable fat accumulation. Supplementation of artichoke water extract improves these histopathological findings

Conclusion

Our findings indicated that artichoke water extract could be helpful as dietary supplement in case of obesity induced by hyperlipidemic diet. This may due its bioactive compounds content those posses beneficial effects in reducing body weight gain, controlling serum lipid abnormalities and improving liver enzymes.

References

Klop B, Elte JWF, Cabezas MC. Dyslipidemia in obesity: mechanisms and potential targets. *Nutrients. 2013 Apr;5(4):1218-40*.

London E, Lala G, Berger R, Panzenbeck A, Kohli AA, Renner M, et al. Sucrose access differentially modifies 11β-hydroxysteroid dehydrogenase-1 and hexose-6- phosphate dehydrogenase message in liver and adipose tissue in rats. *J Nutr. 2007 Dec; 137(12):2616-21*.

Fantuzzi G. Adipose tissue, adipokines, and inflammation. *J Allergy Clin Immunol. 2005 May; 115(5):911-9*.

Roushandeh, A. M., Salehi, I., & Mortazavi, M. (2015). Protective effects of restricted diet and antioxidants on testis tissue in rats fed with high-fat diet. *Iranian biomedical journal*, *19*(2), 96.

Bakos HW, Mitchell M, Setchell BP, Lane M. The effect of paternal diet-induced obesity on sperm function and fertilization in a mouse model. *Int J Androl. 2011Oct; 34(5 pt 1):402-10*.

Dianita, R., Jantan, I., Jalil, J., &Amran, A. Z. (2016). Effects of Labisiapumila var alata extracts on the lipid profile, serum antioxidant status and abdominal aorta of high-cholesterol diet rats. *Phytomedicine*, *23*(8), 810-817.

Joy JF, Haber SL. Clinical uses of artichoke leaf extract. Am J Health Syst Ph 2007;64:1906–9.

Lupattelli G, Marchesi S, Lombardini R, Roscini AR, Trinca F, Gemelli F, et al. Artichoke juice improves endothelial function in hyperlipemia. Life Sci 2004;
76:775–82.

Bonomi BM (2001) La Rivista di Scienzadell'Alimentazione 30: 361–370

Norbert, W.T., 1995. Clinical Guide to Laboratory Tests, Third ed. Saunders W.B. Company, Philadelphia

Friedewald, W.T., K.T. Levy and D.S. Fredrickson, 1972. Estimation of the Concentration of low density lipoprotein Cholesterol in Plasma Without use of the Preparative Ultracentrifuge. Clin. Chem., 226: 499-504.

Harnafi, H., Caid, H.S., Bouanani, N.H., Aziz, M., Amrani, S., 2008. Hypolipemic activity of polyphenol-rich extracts from Ocimumbasilicum in triton WR-1339-induced hyperlipidemic mice. Food Chem. 108, 205–212

Salem, M. B., Affes, H., Ksouda, K., Dhouibi, R., Sahnoun, Z., Hammami, S., & Zeghal, K. M. (2015). Pharmacological studies of artichoke leaf extract and their health benefits. *Plant foods for human nutrition*, *70*(4), 441-453.

Wang M, Simon JE, Aviles IF, He K, Zheng QY, TadmorY. Analysis of antioxidative phenolic compounds in artichoke (*Cynara scolymus* L.). J Agric Food Chem 2003; 51:601–8.

Schaffer JE. Lipotoxicity: when tissues overeat. CurrOpinLipidol2003; 14:281–7.

Shimoda H, Ninomiya K, Nishida N, Yoshino T, Morikawa T, Matsuda H, Yoshikawa M (2003). Anti-hyperlipidemic sesquiterpenes and new sesquiterpene glycosides from the leaves of artichoke (*Cynara scolymus* L.): structure requirement and mode of action. Bioorg. Med. Chem. Lett., 13: 223-228.

Mocelin, R., Marcon, M., Santo, G. D., Zanatta, L., Sachett, A., Schönell, A. P., ... & Duarte, M. M. (2016). Hypolipidemic and antiatherogenic effects of *Cynara scolymus* in cholesterol-fed rats. *Revista Brasileira de Farmacognosia*, *26*(2), 233-239.

Marchesini, G.,Moscatiello, S., Di Domizio, S., &Forlani, G (2008). Obesity-associated liver disease. *The Journal of Clinical Endocrinology & Metabolism*, *93*(11_supplement_1), s74-s80

Mehmetçik, G., Özdemirler, G., Koçak-Toker, N., Çevikbaş, U., &Uysal, M. (2008). Effect of pretreatment with artichoke extract on carbon tetrachloride-induced liver injury and oxidative stress. *Experimental and Toxicologic Pathology*, *60*(6), 475-480

Access this Article in Online

Website: www.ijarbs.com

Subject: Biochemistry

Quick Response Code

DOI:10.22192/ijarbs.2018.05.06.013

How to cite this article:

Majd M.Abdulkhaleq, Hanan S. Alnahdi, Rasha H.Hussein. (2018). The Modulatory Role of Artichoke leaves Water Extract on Lipid Status on Rats Fed High Fat Diet. Int. J. Adv. Res. Biol. Sci. 5(6): 131-139.
DOI: http://dx.doi.org/10.22192/ijarbs.2018.05.06.013