Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.4, No.18, 2014

Effect of using Licorice Powder (*Glycyrrhiza Glabra*) Supplemented with Drinking Water at Two Different Doses in Serum Lipid Profile and Blood Proteins of Local Female Rabbit

Drgham Hamza Yousuf Al-Zwean
Veterinary Public Health Department – Veterinary Medicine College – Baghdad University
E-mail : drg.la1960@yahoo.com

Abstract
This study was conducted to elucidate the effects of administration of Glyeyrhiza Glabra (*licorice powder*) supplemented with drinking water in serum lipid profile, proteins of local female rabbits.This experiment was carried at the animal farm, college of Veterinary Medicine, University of Baghdad from 1st May to 30th June 2013. Twenty one local female rabbits included in this study at age of approximately 3-4 months, divided randomly and equally (7each) (body weight was considered) into three groups, first group (untreated) kept as control (C), second group administrated licorice powder (GG) with drinking water and in a rang of 1.75 gm/day, third group also administrated (GG) with drinking water in a rang of 3.5 gm/day administration regime was continued up to end of experiment, all groups were offered alfalfa with concentrate diet and water freely.Blood samples were collected by heart puncture method biweekly and serum samples were obtained to carry out the biochemical test, serum total cholesterol concentration (TC), serum triglycerides (TG), high density lipoprotein – cholesterol (HDL-C), low density lipoprotein – cholesterol (LDL-C), total serum protein, albumin, and globulin. The result of administration Glycyrrhiza Glabra (licorice powder) with drinking water revealed statistically significant differences ($P<0.05$) and remarkable effect between treated and untreated groups for all biochemical parameter on serum lipid profile, serum proteins. Therefore, it could be concluded from this study that using of Glycyrrhiza Glabra (licorice powder) to treated groups it could contribute in decline the blood serum lipids, increase serum total protein and it's fractions, improving animal health when compared with untreated groups.
Keywords : Licorice , proteins , powder , health , lipid .

Introduction

The use of plants for medicinal purposes is an old as the evolution of man himself [1]. Medical plants have valuable contribution to the life , because they are considered as an important nutrition and drug sources , their leaves , stems , roots and seeds contain various chemicals and many active ingredients which can be used for the treatment of different kinds of diseases [2]. Licorice the root of the Glycyrrhiza species , is one of the most frequently employed botanicals in traditional medicine , The history of licorice , as a medicinal plant , is very old and has been used is many societies throughout the millennia [3][4] Glycyrrhiza Glabra (Licorice) that grows in various parts of the world and it has ethnobotanical history [5]. Phytochemical analysis of G. glabra root extract showed that it contains saponin , triterpenes (glycyrrhizin s, glycyrrhetinic acid and liquirtic acid), flavonids (liquirtin , isoflavonoides and formononetin) and other constituents such as coumarins , simple sugar and polysaccharide like starch , pectin , amino acids , tannins , choline, phytosterols , mineral salts and various other substance , glycyrrhizic acid, glycyrrhizin normally being considered to be the main biologically active components [6,7] , which are believed to be partly responsible for anti – ulcer , anti – inflammatory , anti – diuretic , anti – epileptic , antihepatotoxic , anti – viral activities , anti – allergic and anti – oxidant , furthermore the root extracts are reported to exhibit ant- anglogenic activities and radio – protective effects , also the other important compound is glabridin, it is the major flavonoid present specially in licorice , it has various physiological activities such as antimicrobial , anti – tumer promoting , estrogenic and anti – proliferative activity against cancer cells , also affects melanogensis inflammation , low density lipoprotein oxidation [8 , 9 , 10 , 11]. Glabridin is reported to be a pontent antioxidant toward LDL oxidation , also licorice roots contains flavonoids and polyphenolic flavonoids which have lipophilic characteristic and anti-oxidetive properties , polyphenolic flavonoids can reducing plasma cholesterol level and their ability to inhibit LDL oxidation , Antihyper – lipidaemic and anti – hypertriglyceridaemic properties [12 , 13 , 14]. The aim of present study was undertaken to evaluate the effect of using licorice powder (Glycyrrhiza Glabra) supplemented with drinking water at two different doses in serum lipid profile , proteins and it's fractions of local female rabbit .

Materials and Methods

1. Licorice powder :

Pure licorice powder obtained from licorice extraction factory in Al- Azazia / Kut governorate (www. Licorice-iq. Com)

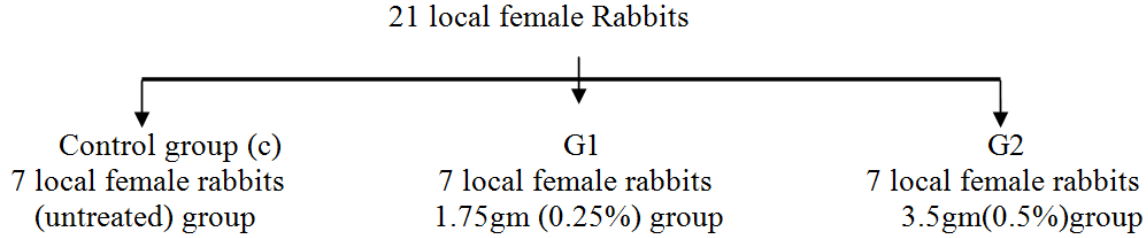
2. Time of the Experiment and location

This experiment was carried out at the Veterinary Medicine college (Animal farm)- Baghdad University from 1st May to 3rd June 2013 to find out the effect of using licorice powder (Glycyrrhiza Glabra) supplemented with drinking water at two different doses in serum lipid profile , Total proteins and it's fractions of local female rabbit .

3. Experimental Design , Animals and sample collection :

Twenty one healthy local female rabbits were bought at age of a bout 3-4 Months , experimental groups were organized as three groups that include seven animals each , body weight was considered as fallow :-

The first group (C) was the control group which did not receive any treatment , G1 and G2 included the animals which were dially administrated G. Glabra (licorice powder) with water at 1.75 gm (0.25%) , 3.5 gm (0.5%) respectively . All groups given free access to Alfalfa , concentrate diet , water adlibitum .



Blood samples were taken biweekly by heart puncture method for biochemical analysis of serum : Total cholesterol , Triglyceride, High density lipoprotein – Cholesterol (HDL-C) , low density lipoprotein- cholesterol (LDL-C) , Total protein concentration and it's fractions .

4. Biochemical assay :

Serum cholesterol [15 , 16 , 23] , triglyceride [17], HDL- C [18,24]

LDL – C (19) , Total protein and it's fractions [21 , 22] levels were measured by commercially available kits (SYRBIO DIGNOSTIC) in spectrophotometer .

5. Statistical analysis :

Serological data were analyzed as a complete Randomized Design (3 treatments) (one way ANOVA) . Least Significant Differences (LSD) was applied to detect the significant differences among different groups means at ($p < 0.05$) level according to [25, 26].

Results

The results of this study revealed that oral administration of licorice powder (Glycyrrhiza Glabra) supplemented with drinking water for 2 month at two different doses (1.75mg , 0.25%) , (3.5gm, 0.5%) show significant decrease in total serum cholesterol (TC) and Triglyceride (TG) when compared with the untreated group (control group), also low – density lipoprotein cholesterol (LDL-C) was markedly reduced in the treated groups in comparison with the untreated group (control) beginning from 3rd week up to the end of experimental periods as shown in table (1,2,3).

Table (1) Effect of licorice powder(Glycyrrhiza Glabra) with drinking water in total serum cholesterol concentration (mg / dl) of local female rabbit (mean ± SE) .

Time / Groups	1st week	3rd week	5th week	7th week	9th week	LSD
C control	A 135.5±12.2	A 58.1±12.8	A 68.9±13.1	A 101.7±5.5	A 89.8 ±4.6	18.2
G1 1.75 gm (0.25%)	C 38.5±3.9	B 38.1±5.1	B 46.7±3.9	B 38.7±3.6	B 35.9±1.9	
G2 3.5 gm (0.5%)	B 86.1±11.4	AB 53.2±8.4	B 48.2±6.2	B 44.4±4.5	B 32.8±1.9	

Capital letters denote Significant differences among treatment groups at ($P<0.05$) level.

Table (2) Effect of licorice powder (Glycyrrhiza Glabra) with drinking water in Triglyceride concentration (mg/dl) of local female rabbit (mean ± SE)

Time / Groups	1st week	3rd week	5th week	7th week	9th week	LSD
C control	B 6.4±1.6	A 85.2±8.8	62.6±6.2	A 77.2±4.3	A 83.1±3.1	13.8
G1 1.75 gm (0.25%)	B 53.5±4.9	B 54.8±4.8	57.2±7.6	A 66.9±6.3	B 64.4±4.4	
G2 3.5 gm (0.5%)	A 86.7±5.1	B 52.2±6.3	57.9±4.4	B 47.2±2.3	B 44.2±1.5	

Capital letters denote Significant differences among treatment groups at (P<0.05) level.

Table (3) Effect of licorice powder (Glycyrrhiza Glabra) with drinking water in low- density lipoprotein cholesterol (LDL.C) concentration (mg/dl) of local female rabbit (mean ± SE)

Time / Groups	1st week	3rd week	5th week	7th week	9th week	LSD
C control	13.7±4.4	A 100.2±9.2	A 118.02±20.9	A 112.3±11.3	A 125.8±10.7	25.4
G1 1.75 gm (0.25%)	26.1±0.9	B 68.4±9.4	B 90.3±7.7	B 88.2±5.3	B 75.2±3.9	
G2 3.5 gm (0.5%)	33.4±8.6	A 101.3±14.2	AB 109.5±14.9	B 69.3±7.4	B 48.4±4.1	

Capital letters denote Significant differences among treatment groups at (P < 0.05) level.

While the table (4) revealed a significant (p < 0.05) higher values in High – density lipoprotein cholesterol (HDL-C) in treated groups at 5th week of experiment when compared with untreated group (control) up to end of experiment.

Table (4) Effect of licorice powder (Glycyrrhiza Glabra) with drinking water in high - density lipoprotein cholesterol (HDL-C) concentration (mg/dl) of local female rabbit (mean ± SE)

Time / Groups	1st week	3rd week	5th week	7th week	9th week	LSD
C control	22.7±1.9	83.7±23.1	B 43.2±6.7	B 57.1±3.4	B 69.1±1.8	16.9
G1 1.75 gm(0.25%)	23.8±0.8	86.5±15.2	B 40.6±4.6	B 48.9±3.7	B 69.2±1.9	
G2 1.5 gm (0.5%)	18.8±1.2	80.5±8.6	A 77.3±7.1	A 93.6±3.9	B 96.7±2.8	

Capital letters denote Significant differences among treatment groups at (P < 0.05) level.

Table (5 , 6 , 7) demonstrates the effect of oral administration of licorice powder supplemented with drinking water on serum total protein , albumen , globulin , the treated groups recorded significantly (p<0.05) higher values in all these fraction than those of control group from beginning up to the end of experimental period.

Table (5) Effect of licorice powder (Glycyrrhiza Glabra) with drinking water in total serum protein concentration (g/dl) of local female rabbit (mean ± SE)

Time / Groups	1st week	3rd week	5th week	7th week	9th week	LSD
C control	B 5.6±0.1	B 5.3±0.01	B 6.4±0.06	B 6.3±0.09	B 6.5±0.01	0.36
G1 1.75gm(0.25%)	AB 5.8±0.2	AB 6.2±0.05	AB 6.8±0.07	AB 7.1±0.05	A 7.3±0.03	
G2 3.5gm(0.5%)	A 6.1±0.1	A 6.5±0.03	A 6.9±0.05	A 7.4±0.03	A 7.7±0.04	

Capital letters denote Significant differences among treatment groups at (P < 0.05) level.

Table (6) Effect of licorice powder (Glycyrrhiza Glabra) with drinking water in serum albumin concentration (g/ dl) of local female rabbit (mean ± SE)

Time / Groups	1st week	3rd week	5th week	7th week	9th week	LSD
C control	B 2.6±0.1	B 2.9±0.03	B 3.0±0.1	B 3.2±0.03	B 3.1±0.02	0.28
G1 1.75gm (0.25%)	AB 2.9±0.2	B 2.9±0.2	AB 3.1±0.2	B 3.3 ±0.07	A 3.6±0.05	
G2 3.5gm (0.5%)	A 3.0±0.06	A 3.3±0.06	A 3.5±0.06	A 3.7±0.01	A 4.1±0.01	

Capital letters denote Significant differences among treatment groups at ($P < 0.05$) level.

Table (7) Effect of licorice powder (Glycyrrhiza Glabra) with drinking water in serum globulin concentration (g/ dl) of local female rabbit (mean ± SE)

Time / Groups	1st week	3rd week	5th week	7th week	9th week	LSD
C control	B 1.5±0.09	B 1.9±0.05	B 1.7±0.10	B 2.0±0.08	B 2.1±0.01	0.39
G1 1.75gm(0.25%)	A 2.1±0.05	B 2.4±0.03	B 2.7±0.01	B 2.9±0.17	B 3.1±0.05	
G2 3.5gm(0.5%)	A 2.4±0.03	A 2.9±0.07	A 3.2±0.07	A 3.6±0.08	A 3.8±0.06	

Capital letters denote Significant differences among treatment groups at ($P < 0.05$) level.

Discussion

The significant decrease in (TC , TG and LDL – cholesterol) and the significant increase ($p < 0.05$) in (HDL – Cholesterol) in rabbits receiving licorice powder (Glycyrrhiza Glablra) (treated groups) as compared to the untreated group (Control). High level of total serum cholesterol is one of the major risk factor for many vascular and heart diseases like (coronary heart diseases) and it is well known for hyperlipidemia, incidence of atherosclerosis , increase in diabetes and hypertension [27,28]. Because the liver play a pivotal role in lipid homeostasis with some other tissues participate in the uptake , oxidation and metabolic conversion of free fatty acid , synthesis of cholesterol and phospholipids and secretion of some specific classes of plasma lipoprotein [29 , 30]. Lowering the level of serum lipid through dietary or drug therapy this lead to decrease the risk of vascular disease and many complications , though there was a large class of hypolipidemic drugs can be used , none of the existing ones available worldwide is fully effective , absolutely safe and free from side effect [31]. Many efforts are being made to find out effective and safe agents that may be beneficial in correcting the lipid metabolism and preventing cardiac diseases . Among natural materials , medical plants have been shown to have properties like anti-hyperlipidemic[14 , 32 , 33].

The result of this study reveals significant reduction in total serum Cholesterol , Triglyceride , LDL-C as shown in table 1 , 2 , 3 this is agreement with many study [4,13, 14 ,33], that attributed the hypocholesterimic effect of using licorice powder Glycyrrhiza glabra) to the presence of many phytochemical constituents isoflavones and flaronids which act as anti – oxidant via inhibition of LDL – cholesterol oxidation , also the glycosides of licorice prevent accumulation of cholesterol in cells [4,5,32,34]. The significant increase ($p < 0.05$) in HDL – Cholesterol level in treated group compared with control group (table 4) is considered beneficial because the high HDL – C levels could potentially contribute to anti – atherogenesis including inhibition of LDL oxidation to protect the endothelial cells from the cytotoxic effects of oxidized LDL [4,27,35].

Also the significant decline in serum LDL – Cholesterol in treated groups could be correlated with the saponin content of licorice powder that enhances the hepatic LDL- receptor levels and increase hepatic uptake of (LDL-C) and aids it catabolism to bile acid [36] , also the saponin is known to lower triglyceride by in habiting pancreatic lipase activity , and on the other hand the effect of phytosterol content of licorice on triglyceride metabolism through a decreased absorption of dietary chdesterol [12 , 37]. The phytosterols and saponine in Glycyrrhiza Glabra could be important in cholesterol elimination , and the phytosterds are reported to displace intestinal cholesterol and reduce cholesterol absorption from intestine [38,39], saponins are capable of precipitating cholesterol from micelles and interfere with enterohepatic circulation of bile acid , making in unavailable for intestinal absorption [13,14,33].

On the other hand , the flavonoids as natural materials and phytochemical constituents were suggested

to lower blood cholesterol level by two mechanisms initially it enhance the phosphorylation of (HMG - COA) reductase (beta – hydroxyl- beta – methylglututaryl – COA reductase) indirectly thus diminishes endogenous cholesterol production, Secondly flavonoides probably exert their influence on steroid metabolism by binding to cytoplasmic steroid receptor due to hydrophobicity of their aglycones protein . Alternatively , the flavonoids may intercalate it between the base of DNA segments , leading to transcription of gene involved in lowering blood cholesterol level [40] . However , the inhibitory mechanism of flavonoides on cholesterol synthesis are yet unknown [34,40]. Either, the hypothyroidism is a well established cause of hyperlipidemia and elevated (LDL-C) in animals and human [41,42] . Thyroid hormone (T3) influence hepatic cholesterol metabolism and play an important role in the regulation of cholesterol 7- hydroxylase , the rate limiting enzyme in bile acid synthesis [43].

As for serum total protein and it's fraction albumin , globulin were slightly and gradually increased with time progress of treatment up to the end of experimental period table [5,6,7] showed that the treated groups significantly ($p < 0.05$) higher values than untreated group (control), this could be attributable to the phytochemical component of Glycyrrhiza Glabra like saponin , isoflavonoides , flavonoids , amino acids , phytosterols , and various other substances that normally being considered to be the main biologically active components which support the body health either systems or organs like liver as antihepatotoxic and anti – inflammatory , in addition to this the liver play a pivotal and main organ in protein synthesis [5,6,9,12] , also the flavonoides as anatural materials act as antioxidant that prevent and protect the liver from any injury or stress and due to this, the synthesis of proteins and it's component could be due to an increase in the metabolic process of liver and all cells of body specially the center of protein synthesis in cells like ribosomes [32 , 37 , 44].

Also the increase in the serum globulin as was noticed in the study could be due to that phytochemical component of Glycyrrhiza Glabra that supplemented to treated groups may plays positive effect and stimulate the humeral immunity to produce globulines and this agreed with those found by [4,5,7,8] when using herbal therapy as alternative medicine .

Conclusion:

It could be concluded from this study reveals that using of the licorice powder (Glycyrrhiza Glabra) supplemented with drinking water at two different doses had various effect on female rabbit to reduction of serum lipide profile , increase serum total protein and it's fraction and this could be contribute to improving animals health.

References

1. Chakravarty , H.L and Al- Rawi , A (1988) . Medicinal plants of Iraq . National Herbarium of Iraq.
2. Shofali ; A. (2003) . Treatment with herbal and medical plants. Alternative Medicine. International Academia ; Beirut Lebanon.
3. Wang ,Z. (2001). Licorice and cancer . Nutrition and Cancer . 39 : 1-11 .
4. Asgary , S., Jafari Dinan , N., Madani , H., Mahzoni , P.,and Naderi, GH.,(2007) . Effect of Glycyrrhiza glabra Extract on Aorta Wall Atherosclerotic Lision in Hypercholesterlemic Rabbits . Pakistan Jaurnal of Nutrition 6 (4) :313 - 317.
5. Maysoon,MN., Arieg, AW., Jazaer, Ab., and Ghassan ,M.,(2011). Biological study of the effect of licorice roots extract on serum lipid Profile , liver enzymes and kidney function tests in albino mice . African Journal of Biotechnology 10(59):12702 -12706 .
6. Hai, Z. H.; Bing, K.; Yong, Y.B.; Yong, B.; and Yan, G. (2011) Hepatoprotective and antioxidant effects of licorice extract against CCl4 Induced oxidative damage in rats . Int. J. Mol. Sci 12, 6529 – 6543.
7. Nabila , M.R. and Manal, L.K.(2012) Free Radical Scavenger Effect of Licorice on the Experimental Rats. Journal of Applied Sciences Research , 8(8): 4704 -4710 .
8. Fujisawa,Y.; Shamoto ,M.; Matsushita ,M.(2000). Glaycyrrhiza inhibits the lytic pathway of complement : possible mechanism of its anti – inflammatory effect on liver .Microbiol . Immunol .44,799- 804.
9. Fu, B., Liu ,J.; Li , H. (2005). The application of macroporous resins in the separation of licorice flavonoids and glycyrrhizic acid .J. Chrom.A.1089 , 18 – 24 .
10. Khatta. KF.; Simpson, TJ. (2010). Effect of gamma irradiation on the Antimicrobial and free radical scavenging activities of glycyrrhiza glabra Root . Radiat . phys .chem., 79: 507–512.
11. Wan,X.Y.; Luo, X.D., and He,P.(2009). Hepatoprotective and anti-hepatocarcinogenic effects of glycyrrhiza and matrine . Chem..Biol. Interact 181: 15 -19 .
12. Fuhrman , B, and Aviram , M. (2001). Flavonoieaseds protect LDL from oxidation and attenuate atherosclerosis . Curr. Opin . Lipidol.12:41-48.
13. Fuhrman , B., Volkova , N.; Kaplan , M.; Presser ,D., Attias , J.;Hayek, I; and Aviram, M.(2002). Antiatherosclerotic effect of licorice extract supplementation on hypercholesterolemic patients: Increased resistance of LDL to atherogenic modifications reduced plasma Lipid levels and decreased

systolic blood pressure . Nutrition.18:268-273.
14. Maurya , Sk.; Raj , K.; Srivastava , AK. (2009) Antidyslipidaemic activity of Glycyrrhiza glabra in high fructose diet induced dislipidaemic syrian golden hamasters . Indian. J. Clinc. Biochem 24 : 404 – 409 .
15. Burstein , M ; Scholnik ,H.R. and Morfin, R.(1980) Rapid Method for the isolation of lipoproteins from human serum by precipitation polyanions. Scand .J. clin. Lab. Invest 40: 583 – 595 .
16. Rifai , N.; Bachorik , P. and Aibers , J.(1999). Lipids, Lipoproteins and apolipoproteins In: Burtis CA, Ashwood ER, editors. Tietz Textbook of Clinical chemistry .3rd ed . Philadelphia :W.B.Saunders Company P 809 – 861 .
17. Fossati , P. and Prencipe , L.(1982) serum triglycerides determined calorimetrically with an enzyme that produces hydrogen peroxide .Clin. Chem. : 28 : 2077 -2080 .
18. Grove , T.H (1979). Effect of reagent PH on determination of high density Lipoprotein cholesterol by precipitation with sodium phosphotungstate- magnesium .Clin chem.; 25 : 560 – 564 .
19. Friedewal , W.; Levy , Y. and Fredrickson , N.(1972). Estimation of the Concentration of low- density lipoprotein cholesterol in plasma without use of preparative ultracentrifuge. Clin . Chem., 18: 499 -502 .
20. Henry, R. J.; cannon, D.C. and Winkelman, J.W.(1974). Clinical chemistry Principles and Techniques; 2nd (ed). Harpor and Row.
21. Doumas, B.T.; Wastom, W,A and Bigges, H.G(1971). Clinical chemistry Acta; 31 : 87.
22. Coles, E. N. (1986). Veterinary Clinicalpathology 4th (ed). W.B. Saunders Co. Philadelphia, USA.
23. Quesenberry, KE and Carpenter JW.(2003). Ferrets, Rabbits , and Rodents Clinical Medicine and Surgery , 2nd ed. St. louis, Saunders , P.20 ,151.
24. Thrall ,MA; Weiser , G; Allison , RW and Campell , TW (2005). Veterinary Hematology and Clinical chemistry .Wiley – Blackwell(ed). Lippincot Williams & Wilkins , p 471 – 574 .
25. Steel, R.G. and Torries , J .H. (1980) Principles and procedures of stastistics . Abiometrcal approach , 2nd edition. McGraw well science Ltd .UK. p:332-344 .
26. SPSS. (2013). Statistical package for the social sciences , Version 21 (Win / Mac / Linux) , User's guide SPSS Inc, Chicago III, USA.
27. Chong , PH and Bachenheimer, BS (2000) Current new and future treatments in dyslipdaemia and atherosclerosis. Drugs 60: 55 -93 .
28. Tan,BK ; Tan , CH ; Pushparaj . PN.(2005) Anti – diabetic activity of the semi – purified fractions of *Averrhoa bilimbi* in high fat diet fed – streptozotocin – induced diabetic rats , Life . Sci. 76 : 2827 – 2839 .
29. Hassan , H.; El- Agmy , S.; Gaur , R.; Fernando , A.; Raj, M. and Quhtit, A. (2009). In vivo evidence of hepato – and reno – protective effect of gartic oil against sodium nitrite – induced oxidative stress. Int. J. Biol5(3): 249-255.
30. El- Gendy , S.; Hessien , M.;Abdl Salam, I. ; Morad , M.; El-Magraby . K.; Ibrahim , H.A ; Kalifa , M.H. and El- Aaser , A.A (2007). Evaluation of the possible antioxidant effects of soybean and *Nigella sativa* during experimental hepato carcinogenesis by nitrosamine precursors .Turk. J. Biochem , 32 : 5-1 .
31. Betteridge , J. (1997). Lipid Disorders in Diabetes Mellitus, In: text Book of Diabetes , Pickup JC, Williams ,G . (ed). Blackwell, Science . London. P 1-35.
32. Ross, IA (2001). Glycyrrhiza glabra. Medicinal plants of the world , Chemical constituents , traditional and modern medical uses , Humana press, Totowa , N.J.,2 :191 – 240.
33. Shalaby, AM.; Ibrahim, HS.; Mahmoud, EM. and Mahmoud, AF. (2004). Some Effect of Glycyrrhiza glabra (licorice) roots extract on male rats. Egyptian, J. Not. Toxins .,1 : 83 – 94.
34. Lankin, V.Z., Tikhaze , A.; Kukharchuk, V. and Belenkov, Y.(2003). Antioxident decrease the intensification of LDL in vivo peroxidation during therapy with statins . Mole . Cell. Biochem .249 : 126 – 140 .
35. Assmann , G and Nofer , J.(2003) . Atheroprotective effects of high–density Lipoproteins . Annu. Rev .Med ., 54 : 321 – 341 .
36. Venkatesan, N .; Devaraj , SN. and Devaraj, H. (2003) Increased binding of LDL and VLDL to apo B, E receptors of hepatic plasma membrane of rats treated with fibernat . Eur. J. Nut., 42 : 262 – 271 .
37. Herrog , MG., Feskens, EJ.; Hollman , PC., Katan , MB. and Kromhout , D.(1993) Dietary antioxidant flavonoids and risk of coronary heart disease the zutphen. Lancet .342 : 1007 -1011.
38. Ikeda , I. and Sugano, M. (1998). Inhibition of cholesterol absorption by plant sterols for mass intervention . Curr. Opin. Lipidol 9: 527 – 531.39.
39. Tamir,s., Eizenberg. M., somjen , D.,Izrael , S. and Vaya , J.(2001). Estrogen- like activity of glabrene and other constituents isolated from Licorice root . Steroid Biochemistry and Molecular Biology , 78 : 791 – 298.
40. Stein, J.H. ; Keevil , J.G.; Wiebe , D.A.; Aaschlimann, S.and folts , JD. (1999) . Purple grape Juice improves endothelial function and reduces the susceptibility of LDL cholesterol to oxidation in patients with coronary

disease . Circulation , 100: 1050 – 1055 .
41. Mahley , R.W.; Weisegraber , K.H. and Fares, R.V.J. (1998) . Disorders of Lipid Metabolism In : Textbook of Endocrinology .Wilsson , J.D.; Foster, E.W. ; Kronenberg , H.M. and Larsen , P.R. (eds) William .W.B.Sounders, Pheladelphia ., Pp :1099 – 1153 .
42. Stone , N.J.(1994). Secondary causes of hyperlipidemia . Med .Clin. North , Am . 78 :117 -141 .
43. Drover, V.A.B. and Angelin , A. (2004). Regulation of human cholesterol -7- α-hydroxylase gen by thyroid hormone in transgenic mice . Endocrinology , 145(2) : 574 – 581.
44. Ganong , W. F. (2003). Review of Medical physiology 21st Ed cell physiology. Capt . II. Lang Medical Books / McGraw – Hill , Los Altobbiug4s, California .

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar