Plant Archives Volume 20 No. 2, 2020 pp. 5549-5555 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

ROLE OF AQUEOUS NANOPARTICLES AND PHENOLIC EXTRACT OF *SALVIA OFFICINALIS* L. ON CYCLOPHOSPHAMIDE-INDUCE SOME PHYSIOLOGICAL DEGRADATION IN ALBINO MICE

Roaa M.H. Shoker[1], Laith M.J. Al-Shamma[2] and Hazim Ismaeel Abdul-Barrey Al-Ahmed[3]

[1]Pharmacology Department, Medicine Collage, Waist University, Iraq.
[2]Biology Department, Science Collage, Baghdad University, Iraq.
[3]Biotechnology Research Center, Al-Nahrain University, Iraq.

Abstract

Objective: The study was aimed to evaluate amelioration effects of aqueous nanoparticles and phenolic extracts of *S. officinalis* on some physiological degradation which induced by cyclophosphamide (CP). Methods: In the experiment, 40 animals were taken and divided into 5 groups. Each group contain of 8 mice. Group I negative control with normal saline injected intra peritoneal. Each group from (II to V) are injected with CP intra peritoneal on 0.1ml. While group II, III and IV animal administration with 200 mg/Kg b.w. aqueous extracts, 10 mg/Kg b.w. phenolic extract, 10 mg/Kg b.w. NPs aqueous extracts, respectively. Group V positive control without plants extract treated. Blood samples were collected from direct heart puncture after 21 day. Results: The results indicated the total cholesterol, triglycerides, ALT, AST, and ALP were significantly increase at ($p \leq 0.05$) in mice which treat 40 mg/kg b.w. CP drugs. While when administration aqueous, phenolic, NPs aqueous extract of *S. officinalis* this parameters reduce significantly at ($p \leq 0.05$). And the results showed no significant differences in HDL level between all treatments. Conclusions: From this review can be concluded that synthesis AgNPs mediated by *S. officinalis* aqueous extracts, and the plant have an efficient activity against Hyperlipidemia.

Key words : Medicinal plants, Nanoparticles, *Salvia officinalis*, Cyclophosphamide drugs, Phenolic Extracts, Lipid Profile.

Introduction

Phytochemical screening of therapeutic plants has added a high deal for finding the new drugs. A several of therapeutic plants have been exposed to developed chemical studies and this has led to the separation of pure bioactive compounds which have been pharmacologically assessed (Kumar *et al.,* 2015). Chemotherapy treat different cancer kinds proficiently, but it cusses acute side effects. Chemotherapy like CP not acts only on the active cells, like cancer cells, but moreover acts on the healthy cells (Abdel-Hafez *et al.,* 2017). Oxidative stress, that is produced by great concentration of free radicals in cells and tissues, may be produced by several negative agent, such as X-ray radiation, UV, gamma, smoking, contaminated diet, alcoholism, harmful ecological factors, drug addiction and exhaustive physical exertion (Serafini and Peluso, 2016; Bi *et al.,* 2017). Several plants have antioxidants constituent such as vitamin C and E, flavonoids, carotenoids, and tannins, etc. that may be utilized to scavenge free radicals from human body (Sharma *et al.,* 2011). “Green nanotechnology” in nanoparticle biosynthesis is increasing between researchers, due to their biological and physicochemical properties, have utilization in several fields, having drug delivery, magnetic devices, sensors, optoelectronics, and focuses on the green synthesis of silver nanoparticles (AgNPs) by utilizing plant sources (Chung, *et al.,* 2016). Aqueous extracts of *S. officinalis* and *R. communis* have the ability to reduce silver nitrate ions to silver nanoparticles (Salem *et al.,* 2012). *S. officinalis* important action on dyslipidemia can be associated to flavonoids found in the plant, this flavonoid increasing mitochondrial DNA content, mitochondrial size, and gene expression associated to mitochondrial biogenesis (Seo *et al.,* 2015). Dent *et al.,* (2017) showed that sage is polyphenols rich, which indicated have antioxidant activity. *S. officinalis L.* was present to have relative cardio-protective active by increasing blood HDL cholesterol levels and reducing total triglyceride, cholesterol, and LDL cholesterol levels in hyperlipidemic patients (Kianbakht *et al.,* 2011). In this research effects aqueous nanoparticles and phenolic extracts of *S. officinalis* were investigated on some physiological degradation which caused by CP.

Materials and Methods

Collection of Plant Samples

Dry arial parts of *S. officinalis* L. was obtained from local markets in Waist Province, Iraq. The plants identified by Dr. Sukeyna Abaas Aliwy Department of Biology/ College of Science/University of Baghdad. After collection, ground into a fine powder by an electric grinder, then stored in clean conditions until use.

Preparation of Plant Extracts

A- Aqueous Extract

Aqueous extract of plants are prepared, weight 100 g of dry powder of plant and place it in conical flask and added 500 ml of distilled water in percentage 1:5 w: v. after that the mixture shacked by electric shaker for 2 hours and left mixture in room temperature. After 24 hours, the mixture was filtered by four layer of gauze and put in tube and centrifuged mixture in centrifuge 2000 rpm to 10 min. The superintend was filtered by Whatman no. 4 filter paper. Filtrate mixture was concentrated by oven for 72 hours to obtain crud extract. This extract was stored in dark sterile screw bottle 4°C until use (Zheng Mu *et al.,* 1990).

B- Crude Phenols Extract

Crude Phenols were extracted according to Harborne (1984). 200 g of plant powder was divided into two equal parts, 300 ml of 1% hydrochloric acid was added to one part, and 300 ml of D.W. was added to the other, the two quantities were transferred to electrical blender for 5 minutes. Then the two mixtures were transferred to boiled water bath for 30-40 minutes, the two mixtures were cooled and filtered through muslin cloth, then transferred to a centrifuge with speed of 3000 rpm for 10 minutes. The two supernatants were mixed. Equal quantity of n-propanol was added to the mixture and sodium chloride was added until the solution was separated into two layers. The lower layer extracted in separating funnel with Ethyl acetate, and the solvent layer was collected and evaporated in a rotary evaporator at 40°C for (1-2) hours. The upper layer was evaporated in a rotary evaporator at 40°C for (1-2) hours the dried material of both layers were mixed and dissolved in 5ml of 96% ethanol, then transferred to oven then the extract was kept in refrigerator until use.

Green Synthesis of silver nanoparticles

Silver nanoparticles synthesis were prepared by Veerasamy *et al.,*(2011).

Analysis of phenolic compounds of the plants extracts by HPLC

Analysis of the phenolic compounds was made by injecting 100 µl of the extract of each sample in High Performance Liquid Chromatogram for identification. The procedure that used outlined by Mradu *et al.,* (2012).

Lipid Parameters

This was intended for in vitro quantitative determination of cholesterol, triglycerides, and HDL cholesterol in serum or plasma by Agappe kits.

Liver Enzymatic Assay

Aspartate aminotransferase AST

The AST enzyme activity was evaluate in mouse serum by using enzymatic colorimetric kit method produced by (Agappe company) and according to Thefeld *et al.,* (1994).

Alanine aminotransferase ALT

The activity of this enzymes was evaluate in blood serum depending on colorimetric method by using enzyme kit produced from (Agappe company) according to Thefeld *et al.,* (1994).

Alkaline phosphatase (ALP)

This was intended for in vitro quantitative determination of Alkaline Phosphatase in serum or plasma according to Klin, (1972).

Results

Plants have a great source of natural compounds like vitamins, terpenoids, phenolic acid, alkaloids lignins, cumarins, tannis, quinones, and flavonoids having varied types of secondary metabolites which have antioxidant properties (Thirunavukkarasu *et al.,*2018). In this work, aerial parts of *S. officinalis* plants were extracted, for detection of aqueous and phenols extracts. Chemical detection of some active compounds of the aqueous extracts of *S. officinalis* was investigated. The results showed the tannins, saponins, resins, coumarins, phenols, alkaloids, flavonoids, terpenes, steroid and volatile oil were indicated the positive result of *S. officinalis* aqueous extracts. While, glycoside absent of this extract. This results also agree with Kadhim *et al.,* (2016) which detected the alkaloids, phenol, saponins, flavonoids, steroids, tannins, and Vitamin C of *S. officinalis* aqueous extracts. While disagreement with him about glycoside was found in positive results of *S. officinalis* aqueous extract.

Characterization of synthesized silver nanoparticles (AgNPs)

Nanoparticles biosynthesis has been considered as a new technique of study. In the continues study, the green chemistry of silver nanoparticles synthesis from aqueous solution as a fast ecofriendly technique was defined (Daoud *et al.,* 2015). In this work, silver nanoparticles were prepared by green method and characterized by using Atomic Force Microscope (AFM). Aqueous extracts of this plants performance as reducing agent through exposure to silver nitrate, silver ions reduction into silver nanoparticles which was observed as a result of the color change. The color change was due to the Surface Plasmon Resonance phenomenon as Fig. 1.

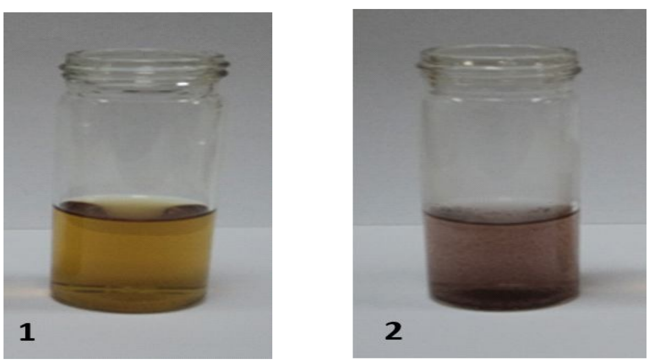

Fig. 1: Nanoparticles samples.

1-*S. officinalis* aqueous extract, 2- *S. officinalis* NPs Aqueous extract. After stirring 20min at 75°C.

The results in this work agree with other researcher, Salem *et al.,* (2012) showed that the aqueous extracts of *S. officinalis* and *R. communis* have the ability to reduce silver nitrate ions to silver nanoparticles. The color change was yellowish-brown due to the Surface Plasmon Resonance phenomenon. Rajendran and Prabha, (2016) showed the reduction of silver ions to silver nanoparticles might be a periodical color change**.** AFM was one of the primary tools for determining imaging and manipulating matters at the nanoscale (Li *et al.,* 2011). Homogeneous distribution of silver nanoparticles was observed AFM three dimension images. Fig. 2 shows the AFM images of AgNPs appear the globally spherical shape and nanoparticles agglomeration which prepare by *S. officinalis*.

Granularity distribution chart was obtained from AFM software for biological methods which gives the particles size distribution of AgNPs (Fig. 3), diameter average of the biosynthesis AgNPs particle was (63.24 nm). Ismail (2019) showed the average dimeter for biosynthesis AgNPs particle from aqueous extracts of *Trigonella foenum-graecum*(fenugreek) was about 56.12nm.

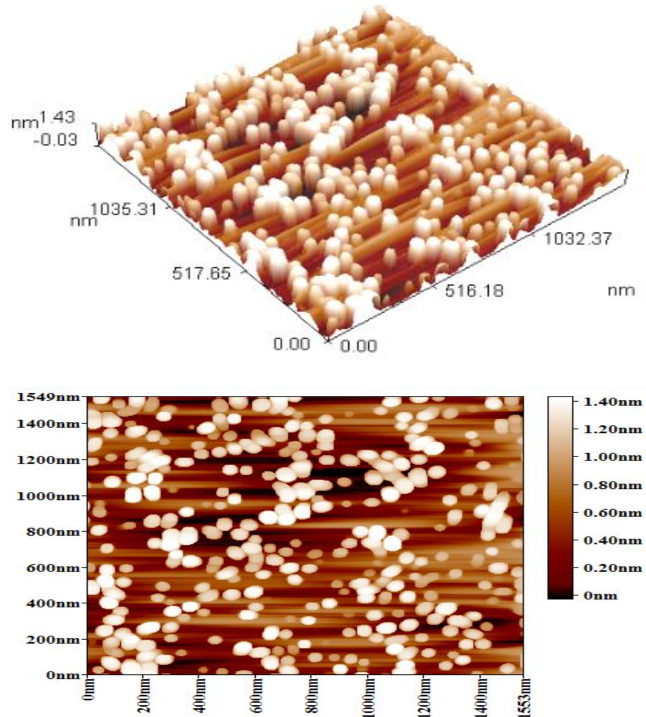

Fig. 2: Topography and three-dimensional images showing the globally spherical shape of the prepared particles of *S. officinalis*.

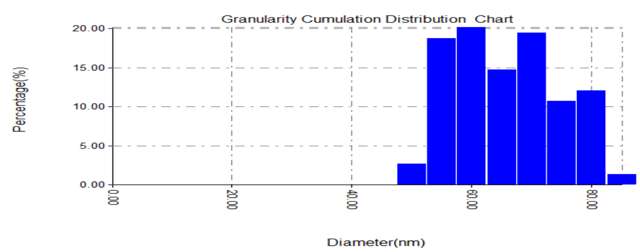

Fig. 3: Granularity distribution chart obtained from AFM software of *S. officinalis* NPs aqueous extracts.

Chemical constituents of the plants extracts

Results of HPLC analysis indicated the presence of 4 phenolic compounds in plants. All the isolated compounds appeared to have different retention time. These constituent concentration showed in table 1 and Figs 4, 5, 6, 7 and 8.

Blood biochemical parameters

Lipid Profile

Cyclophosphamide was a common anticancer drugs utilized for the treatment of numerous malignancies. However, upon treatment, it makes cute toxicity due to

Table 1: Types and concentration of phenolic constituent in plant extract.

Phenolic compounds (µg/ml)	*S. officinalis*
Epigenin	276.54
Kaempferol	146.50
Quercetin	368.34
Catechin	1254.53
Total concentration (µg/ml)	3045.91

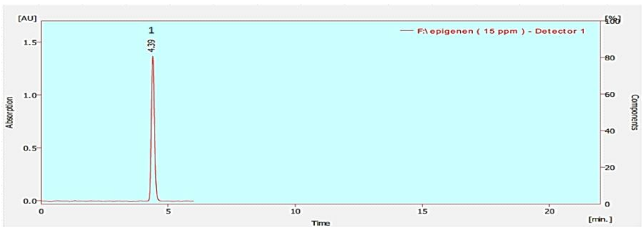

Fig. 4: HPLC profile of Phenols Standard (1) epigenin.

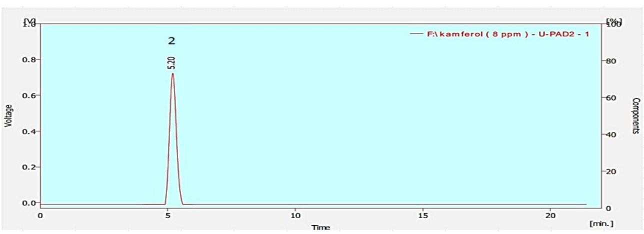

Fig. 5: HPLC profile of Phenols Standard (2) kaempferol.

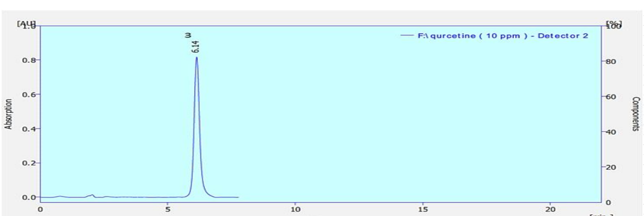

Fig. 6: HPLC profile of Phenols Standard (3) quercetin.

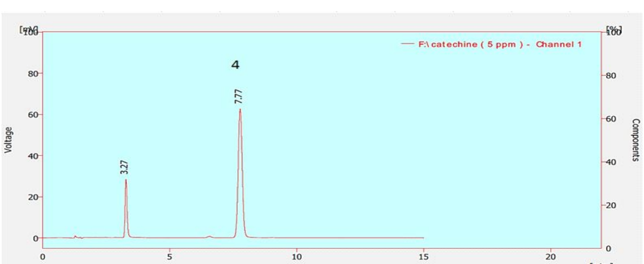

Fig. 7: HPLC profile of Phenols Standard (4) catechin.

its oxidative stress ability (El-Naggar *et al.,* 2015). Administration CP drugs in experimental mice for 21 days make a marked changes in blood lipid profile such as total cholesterol and triglycerides which was studies in

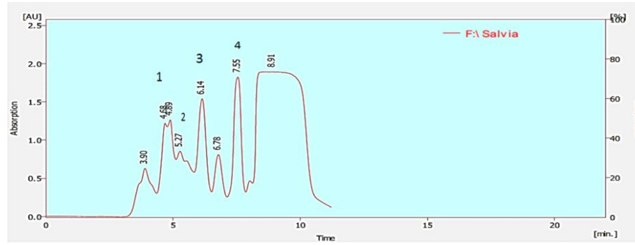

Fig. 8: HPLC profile of *Salvia officinalis* Phenols (1) epigenin, (2) kaempferol, (3) quercetin, (4) catechin.

table 2. Total cholesterol and triglycerides were significantly increased at ($p \leq 0.05$) in mice which treated CP drugs (170.73+3.40 mg/dl),(167.12+6.40 mg/dl) as compare with the control (90.71+6.29 mg/dl), (59.44+4.18 mg/dl) respectively. Several classes of drugs to be considered as common causes of altered lipid profiles (Varghese *et al.,* 2017). Results showed aqueous extracts of *S. officinalis* reduced significantly at ($p \leq 0.05$) total cholesterol and triglycerides (147.79±4.45 mg/dl), (140.49 ± 3.56 mg/dl) compare with CP group. Total cholesterol and triglycerides were reduced significantly at (pd" 0.05) in group of mice which were treated with phenolic extracts (140.95±4.88 mg/dl), (109.79±53.85 mg/dl) respectively. These results agree with previous study which showed *S. officinalis L.* was decreased total triglyceride, cholesterol, and LDL cholesterol levels in hyperlipidemia patients (Kianbakht *et al.,* 2011). Alenzi *et al.,* (2016) mention treatment with *N. sativa* L oil which have active constituent, thymoquinone, may decrease cyclophosphamide-induced toxicity. In this study nanoparticles were teste to reduce side effects of anticancer drugs. The results show higher reduce significantly at (pd≤0.05) of total cholesterol and triglycerides in group of mice which were treat with NPs aqueous extracts (105.47±7.30 mg/dl), (100.57±8.59 mg/dl) respectively. While results indicate no significantly of high density lipoproteins (HDL) in all treatment. The coated AgNPs with *S. officinalis* have promising possible as a source for the progress of chemotherapeutic drugs in future (Baharara, *et al.,* 2017). Ismail, (2019) showed aqueous extract and green AgNPs of *T. foenum-graecum* seed which reduced significantly ($p \leq 0.05$) triglyceride, cholesterol, and LDL-cholesterol level in serum of Streptozotocin diabetic mice. No-significant differences in HDL level between all studied.

Liver Enzyme

CP was induced severe liver damage which showed by elevated serum ALT and AST accompanied by increased hepatic oxidative stress and inflammatory biomarkers (Mansour *et al.,* 2017). Even low doses of CP may causes significant hepatotoxicity in humans which

Table 2: Lipid profile (TG,HDL,andTC) levels of mice groups after 21 days as (mean±SD).

Parameters / Groups		TG mg/dl (mean±SD)	HDL mg/dl (mean±SD)	TC mg/dl (mean±SD)
I	Control	A59.44 ± 4.18	A22.720 ± 2.977	A90.71 ± 6.29
II	*S. officinalis* aqueous extract	B140.49 ± 3.56	A20.584 ± 3.165	B147.79 ± 4.45
III	*S. officinalis* phenolic extract	C109.79 ±53.85	A23.090 ± 2.938	B140.95 ± 4.88
IV	*S. officinalis* NPs aqueous extract	C100.57 ± 8.59	A23.036 ± 3.576	C105.47 ± 7.30
V	Cyclophosphamide	D167.12 ± 6.40	A24.080 ± 2.679	D170.73 ± 3.40
LSD		21.304	Non sign.	10.908
P-value		0.00017	0.500	0.00024

Table 3: Liver Enzyme(ALT, AST, Alp) levels of experimental mice (Mean ±S.D.).

Parameters / Groups		ALT U/L (mean±SD)	ALT U/L (mean±SD)	ALT U/L (mean±SD)
I	Control	A31.754±2.759	A51.144±3.653	A203.81±11.65
II	*S. officinalis* aqueous extract	B53.260±6.869	B68.304±3.357	B219.25±2.72
III	*S. officinalis* Phenolic extract	C40.704±3.703	C61.122±3.759	A200.84±2.73
IV	*S. officinalis* NPs Aqueous extract	A29.298±2.771	A50.372±4.280	C170.46±3.22
V	Cyclophosphamide	D68.570±2.622	D78.466±3.598	D232.48±7.52
LSD		4.425	3.958	5.918
P-value		0.00014	0.00006	0.00022

often act as a barrier against its clinical uses (Cuce *et al.,* 2015). ALT, AST, and ALP showed increased significantly at ($p \leq 0.05$) in CP groups (68.570±2.622 mg/dl), (78.466±3.598 mg/dl), and (232.48±7.52 mg/dl) as compared with control (31.754±2.759 mg/dl), (51.144±3.653 mg/dl), (203.81±11.65 mg/dl) respectively, (Tables 3). Shokrzadeh *et al.,* (2014) observed serum ALT, AST, and ALP levels were increased significantly at ($P \leq 0.001$) in all mice injected with 200 mg/kg of CP when compared to the untreated control animals, the serum ALT, AST, and ALP levels of the CP groups were (123.78± 4.24IU/l) (96.18± 2.07 IU/l) (185.86 ± 5.37 IU/l) while the control groups (42.37± 1.46 IU/L) (31.39±1.48 IU/l) (52.28±1.29 IU/l), respectively. Dina *et al.,* (2019) showed the hepatic enzymes AST, and ALT in serum were significantly increased at ($P \leq 0.05$) in CP-treated rats when compared with the control. ALT, AST, and ALP activity reduced significantly at ($P \leq 0.05$) in aqueous and phenolic extracts of *S. officinalis* plants groups, when compared with CP group. ALT levels were (53.260±6.869 mg/dl), (40.704±3.703 mg/dl) within a serum normal range. While AST levels (68.304±3.357 mg/dl),(61.122±3.759 mg/dl). And ALP levels (219.25±2.72 mg/dl), (200.84±2.73 mg/dl) frequency. Results indicated present significant different between aqueous and phenol extracts. Results showed higher effects to reduced ALT, AST, and ALP activity of *S. officinalis* NPs aqueous extract were (29.298±2.771 mg/dl), (50.372±4.280 mg/dl), and (170.46±3.22 mg/dl) respectively when compare with CP group (68.570±2.622 mg/dl), (78.466±3.598 mg/dl) (232.48±7.52 mg/dl). These plants act as hepatoprotective agent, due to they contained compounds and vitamins with antioxidant activities. *S. officinalis* have hepatoprotective activity and so utilize this plant for treating liver disorders (Parsai *et al.,* 2014). Ibrahim, (2014) showed ALT, AST, and ALP levels significantly increased at ($P \leq 0.05$) in rats group which treated with $Mncl_2$ as compared with a control group, and ALT, AST significant decrease at ($P \leq 0.05$) in rats groups treated with Mncl2 and aqueous extracts of *S. officinalis* compared with $Mncl_2$ group. ALP decreased significantly ($P \leq 0.05$) in groups treated with the extract compared with $Mncl_2$ group. Hong *et al.,* (2015) showed several phytochemicals and medicinal herbs have been examined as complementary and alternative treatments for acute liver diseases. Due to hypolipidemic drugs are extensively in addition to these drugs have other adverse effects. In India approximately 150 medicinal plants have been utilized as herbal drugs against Hypolipidemic. Due to herbal drugs is significantly have slight side effects compared with the synthetic hypolipidemic drugs (Srivastava and Srivastava, 2018).

References

Abdel-Hafez, S.M.N., R.A. Rifaai and W.Y. Abdelzaher (2017). Possible protective effect of royal jelly against cyclophosphamide induced prostatic damage in male albino rats; a biochemical, histological and immuno-histo-chemical study. *Biomed. Pharma-cother.*, **90:**15-23.

Alenzi, F.Q., Y.E. El-Bolkiny and M.L. Salem (2016). Protective effects of *Nigella sativa* oil and thymoquinone against toxicity induced by the anticancer drug cyclophosphamide. *Br. J. Biomed. Sci.*, **67(1):** 20-28.

Baharara, J., T. Ramezani, M. Mousavi and M. Asadi-Samani (2017). Antioxidant and anti-inflammatory activity of green synthesized silver nanoparticles using *Salvia officinalis* extract. *Ann. Trop. Med. Public Health*, **10(5):**1265-1270.

Bi, X., J. Lim and C.J. Henry (2017). Spices in the management of diabetes mellitus. *Food Chem.*, **217:** 281-293.

Chung, I.M., I. Park, K. Seung-Hyun, M. Thiruvengadam and G. Rajakumar (2016). Plant-Mediated Synthesis of Silver Nanoparticles: Their Characteristic Properties and Therapeutic Applications. *Nanoscale Research Letters*, **11(1):** 40.

Cuce, G., S. Cetinkaya, T. Koc, H.H. Esen, C. Limandal, T. Balci, S. Kalkan and M. Akoz (2015). Chemoprotective effect of vitamin E in cyclophosphamide-induced hepatotoxicity in rats. *Chem. Biol. Interact.*, **232:** 7-11.

Daoud, S., M.A.M. Alqahtani, D.H.M. Alkhalifah, M.M. Elobeid and A.E. Mohammed (2015). Biosynthesis of silver nanoparticales using *salvia officinalls* extracts and assessments of their antibacterial activity. *Int. J. Curr. Res.*,**7(10):** 21548-21552.

Dent, M., D.B. Kovaèeviæ, T. Bosiljkov and V. Dragoviæ-Uzelac (2017). Polyphenolic Composition and Antioxidant Capacity of Indigenous Wild Dalmatian Sage (*Salvia officinalis* L.). *Croat Chem. Acta.*, **90(3):** 451-459.

Dina, R.S., G. El-Karim and G. El-Amrawi (2019). Cyclophasphamide hepatotoxicity: the role of 4-hydroxynonennal and cytochrome C oxidase and the possible protective effect of *Ganoderma lucidum* extract. *Slov. Vet. Res.*, **56(22):** 15-23.

El-Naggar, S.A., A.A. Alm-Eldeen, M.O. Germoush, K.F. El-Boray and H.A. Elgebaly (2015). Ameliorative effect of propolis against cyclophosphamide-induced toxicity in mice. *Pharm. Biol.*, **53(2):** 235-241.

Harborne, J.B. (1984). Phytochemical methods. Chapman and Hall. New York 2nd ed. Pp: 288.

Hong, M., S. Li, H.Y. Tan, N. Wang, S.W. Tsao and Y. Feng (2015). Current status of herbal medicines in chronic liver disease therapy: the biological effects, molecular targets and future prospects. *Int. J. Mol. Sci.*, **16(12):** 28705-28745.

Ibrahim, R.I. (2014). The Efficiency of *Saliva officinalls* to reduce the biochemical and immunological effects induced by manganese chloride in rats. *Eur. Sci. J.,* **10(21)**.

Ismail, H.H. (2019). Antidiabetic activity of silver nanoparticles synthesis from Fenugreek seeds extract in induced diabetic mice. M.Sc. thesis, College of Science, University of Baghdad. Iraq.

Kadhim, S.M., M.T. Mohammed, O.M. Ahmed and A.M.N. Jassim (2016). Study of some *Salvia officinalls L.* (sage) components and effect of their aqueous extract on antioxidant. *Int. J. Chem. Sci.*, **14(2):** 711-719.

Kianbakht, S., B. Abasi, M. Perham and F. Hashem (2011). Antihyperlipidemic effects of *Salvia officinalis* L. leaf extract in patients with hyperlipidemia: a randomized double-blind placebo-controlled clinical trial. *Phytother Res.*, **25:** 1849-1853.

Klin, Z. (1972). Recommendations of the German Society for Clinical Chemistry. Standardisation of methods for the estimation of enzyme activities in biological fluids. Experimental basis for the optimized standard conditions. *Chem. Klin. Biochem.*, **10(6):** 281-91.

Kumar, S., S. Paul, Y.K. Walia, A. Kumar and P. Singhal (2015). Therapeutic Potential of Medicinal Plants: A Review *J. Biol. Chem. Chron.*, **1(1):** 46-54.

Li, X., H. Xu, Z. Chen and G. Chen (2011). Biosynthesis of nanoparticles by microorganisms and their applications. *J. Nanomater.*, 16.

Mansour, D.F., D.O. Saleh and R.E. Mostafa (2017). Genistein Ameliorates Cyclophosphamide-induced hepatotoxicity by modulation of oxidative stress and inflammatory mediators. *Open Access Maced. J. Med. Sci.*, **5(7):** 836-843.

Mradu, G., S. Saumyakanti, M. Sohini and M. Arup (2012). HPLC Profiles of Standard Phenolic Compounds Present in Medicinal Plants. *I. J. P. P. R.*, **4(3):**162-167.

Parsai, A., M. Eidi and A. Sadeghipourm (2014). Hepatoprotective effect of sage (*Salvia officinalis* L.) leaves hydro-methanolic extract against *Aspergillus parasiticus* aflatoxine-induced liver damage in male rats. *Bull. Pharma. Res.*, **4(3):** 129-132.

Rajendran, R. and A.L. Prabha (2016). AgNPs synthesis, haracterization and antibacterial activity from *Salvia splendens* sellow ex Roem. And Schult. *Plant extract Int. J. Sci. Res.*, **4:**1086-1090.

Salem, A.N.B., R. Zyed, L.M. Ali, S. Nidhal, S. Souad and A. Mahjoub (2012). Cytotoxic effect of nanoparticles synthesized from *Salvia officinalis* L. and *Ricinus communis* aqueous extracts against Vero cell line and evaluation of their antioxidant activities. *Afr. J. Biotechnol.*, **11(52):** 11530 -11534.

Serafini, M. and I. Peluso (2016). Functional foods for health: The interrelated antioxidant and anti-inflammatory role of fruits, vegetables, herbs, spices and cocoa in humans. *Curr. Pharm. Des.*, **22:** 6701-6715.s

Seo, S., M.S. Lee, E. Chang, Y. Shin, S. Oh, I.H. Kim and Y. Kim (2015). Rutin increases muscle mitochondrial biogenesis with AMPK activation in high-fat diet-induced obese rats. *Nutrients*, **7:** 8152-8169.

Sharma, V., R. Paliwal and S.P. Sharma (2011). Phytochemical analysis and evaluation of antioxidant activities of hydro-ethanol extracts of *Moringa oleifera* lam pods. *J. Pharm. Res.*, **4(2):** 554-557.

Shokrzadeh, M., A. Ahmadi, F. Naghshvar, A. Chabra and M.

Jafarinejhad (2014). Prophylactic efficacy of melatonin on Cyclophosphamide-induced liver toxicity in mice. *Bio. Med. Research International*, 6.

Srivastava, R. and P. Srivastava (2018). Lipid lowering activity of some medicinal plants: A review of literature. *Biomed. J. Sci. Tech. Res*., **9(1):** 2574-1241.

Thefeld, W., H. Hoffmeister, E.W. Busch, P.U. Koller and J. Vollmar (1994). Reference values for the determination of GOT, GPT and alkaliphosphatase in serum with optimal standard methods. *Dtsch. Med. Wschr*., **99:** 343-344.

Thirunavukkarasu, P., S. Asha, R. Reddy, D. Priya, R. Hari and N. Sudhakar (2018). Phytochemical analysis of medicinal mangrove plant species *Ceriops decandra*. *Global J. Pharmacol*., **12(1):** 24-30.

Varghese, T., K. Krishnakumar, L. Panayappan and R. Jacob (2017). A review on causes and risk factors of hyperlipidemia. *I. J. P. P. R*., **9(3):** 60-65.

Veerasamy, R., T.Z. Xina, S. Gunasagaran, T.F.W. Xiang, E.F.C. Yang, N. Jeyakumar and S.A. Dhanaraj (2011). Biosynthesis of silver nanoparticles using mangosteen leaf extract and evaluation of their antimicrobial activities. *J. Saudi Chem. Soc*., **15(2):** 113-120.

Zheng-Mu, M., I. Sakai, Y. Ose, T. Sato, H. Nagase, H. Kito, M. Mizuo, K. One and H. Nakane (1990). Antimutagenic activity by medical plants in trailonal Chinese medicines. *Shoy Akugaku Zasshi*., **44(3):** 225-229.