



Efficacy of Clove Oil as an Antioxidant against Radiation Risk in Male Rats

Abdel-Magied, N. and Ahmed, A.G.

Radiation Biology Research Department, National Centre for Radiation Research and Technology (NCRRT), Atomic Energy Authority, P-O-Box29-Cairo, Egypt.

E-mail: nanyabdelmagid@yahoo.com

Received: 04/04/2011.

Accepted: 01/06/2011.

ABSTRACT

The present study was undertaken to evaluate the antioxidant capacity of clove oil (150 mg/kg b.wt) orally administered for 21 consecutive days before irradiation of male rats. Animals were divided into four groups, control rats group, treated rats group, irradiated rats group and treated irradiated rats group. Blood samples were collected 1 and 7 days post irradiation. Exposure of rats to gamma irradiation (6.5Gy) induced significant decrease in glutathione (GSH) content, the activity of superoxide dismutase (SOD), and catalase activities, leutinizing hormone (LH) and testosterone hormone levels in blood while significant elevation in MDA level, total cholesterol level (TC), triglycerides level (TG), low density lipoprotein-cholesterol level (LDL) and follicle stimulating hormone (FSH) was recorded. The data obtained from rats treated with clove oil before whole body gamma irradiation revealed an improvement in antioxidants enzymes activities and concentration of GSH associated with significant reduction of blood MDA concentration, comparing with irradiated rats. Moreover, significant amelioration in the total cholesterol, triglycerides, and FSH, LH and testosterone hormones was recorded. It could be concluded that clove oil exerts a beneficial protective role against radiation induced oxidative stress and some biochemical disorders.

Key words: clove oil, antioxidant, lipid, hormones, rats, γ -rays.

INTRODUCTION

Radiation injury to living cells is too a large extent, due to oxidative stress ⁽¹⁾. Ionizing radiation causes a variety of changes in tissues depending on the radiation dose, duration of exposure and the susceptibility of tissues to ionizing radiations ⁽²⁾. Antioxidants such as glutathione, arginine, citrulline, taurine, creatine, selenium, zinc, vitamin E, vitamin C, vitamin A and tea

polyphenols and antioxidants enzyme such as superoxide dismutase, catalase, glutathione reductase, and glutathione peroxidase exert synergistic actions in scavenging free radicals ⁽³⁾.

Many natural antioxidant, whether consumed before or after radiation exposure, are able to confer some levels of radio protection ⁽⁴⁾. Spices have been used as food seasoning and for medicinal purposes for centuries. Several of them possess hypolipidemic, antiplatelet aggregation, anti tumor and immune stimulate activities. These pharmacological properties may be useful to reduce the risk of cardiovascular disease and cancer. This is due to the presence of phenolic, polyphenolic, terpenoids and carotenoids ⁽⁵⁾.

Traditionally clove has been used as a spice worldwide ⁽⁶⁾. Clove oil is an essential oil from the dried flower, buds, leaves and stems of the tree *Syzygium aromaticum* (Eastern Hemisphere) or *Eugenia caryophyllate* and *Eugenia aromaticum* (western Hemisphere) ⁽⁷⁾. This oil is in the myrtle family (Myrtaceae). A key constituents is Eugenol-75-87 % which is a phenol making this very potent oil ⁽⁶⁾.

Clove has been reported to possess a potent antioxidant activity in vitro⁽⁸⁾, which reduces the oxidative stress in the body ⁽⁹⁾. Many investigators demonstrated the hepatoprotective properties of clove against chemical stress ⁽¹⁰⁾ as against physical stress ⁽¹¹⁾. Clove is reported as aphrodisiac ⁽¹²⁾, stomachic ⁽¹³⁾, carminative, and antispasmodic ⁽¹⁴⁾. It is reported to act as a contraceptive in low doses ⁽¹⁵⁾ and useful in cataract ⁽¹⁶⁾, have anticarcinogenic property ⁽¹⁷⁾. Moreover, clove inhibits platelet aggregation and alters arachidonic acid metabolism in human platelets ⁽¹⁸⁾. The main constituents of the essential oil of clove are phenylpropanoids such as carvacol, thymol, eugenol and cinnaldehyde ⁽¹⁹⁾. The biological activity of clove oil has been investigated in several purposes, including antioxidant properties ⁽²⁰⁾, free radical scavenging ⁽²¹⁾, metal chelation⁽²²⁾, neuroprotection⁽²³⁾, antidiabetic⁽²⁴⁾, antibacterial and insecticidal properties⁽¹⁹⁾, gastroprotective activity⁽²⁵⁾. Eugenol inhibits lipid peroxidation and maintains activities of enzyme superoxide dismutase, catalase, glutathione peroxidase and glucose-6 phosphate dehydrogenase⁽²⁶⁾. The lethal clove oil dose is 3.752 g/kg body weight⁽²⁷⁾.

The present study has been conducted to investigate the hazards effects of exposure to whole body gamma irradiation on male albino rat and to evaluate the possible protective role of clove oil, this included the effect on antioxidants (catalase activity, superoxide dismutase activity, glutathione content) and

malondialdehyde level, total cholesterol, triglycerides low density of lipoprotein-cholesterol as well as follicle stimulating, leutinizing and testosterone hormones.

MATERIALS AND METHODS

Experimental animals: Adult male albino rats weighting 120-150 gm were obtained from the Egyptian organization for biological product and vaccines and kept under normal conditions of pressure, ventilation, temperature and humidity. Animals were fed on standard pellet diet

Radiation exposure: The source of radiation was gamma cell 40 (cesium-137) at the National Center for Radiation Research and Technology, Atomic Energy Authority, Cairo, Egypt. The dose rate at the time of experiment was 0.61 Gy/min. Rats were irradiated with a single dose level of 6.5 Gy.

Experimental design: Animals were divided into four equal groups (n=12).

Group 1: Control. Animals of this group didn't receive any treatment.

Group 2: Clove oil. Animals of this groups received clove oil orally via stomach tube at a dose level 150mg/kg body weight/day for 21 consecutive days.

Group 3: Irradiated. Animals of this group were whole body exposed to gamma irradiation (6.5 Gy) as a single dose.

Group 4: Clove oil + Radiation. Animals of this group received clove oil supplementation for three weeks (150 mg/kg b.wt), then exposed to whole body gamma irradiation.

Animals were sacrificed 1 and 7 days post irradiation. Blood samples were obtained by heart puncture then divided into 2 parts. The 1st part was collected on EDTA to measure glutathione content (GSH), superoxide dismutase (SOD) and catalase activities. Glutathione content was determined according to Beutler, *et al.* ⁽²⁸⁾. The activity of superoxide dismutase (SOD) and catalase was determined according to the methods of Minami and Yoshikawa, ⁽²⁹⁾ and Bergmeyer and Grabe, ⁽³⁰⁾, respectively. The lipid peroxide malonaldehyde (MDA) content was determined according to Yoshioka *et al.*, ⁽³¹⁾.

The 2nd part of the blood was allowed to clot and centrifuged at 3000 rpm for 10 min and the collected serum was stored in a deep freezer for estimation luteinizing hormone (LH) and follicle stimulating hormone (FSH) according to Garrett, ⁽³²⁾, Estimation of testosterone hormone was performed according to the method of Wilson and Foster, ⁽³³⁾, Serum total cholesterol, Low

density lipoprotein cholesterol (LDL) and triglycerides(T.G.) were determined according, to Allain *et al.* ⁽³⁴⁾, Demacker *et al.* ⁽³⁵⁾ and Fossati and Prencipe, ⁽³⁶⁾, respectively.

Data were statistically analyzed using a computer program for student t-test according to Snedecor and Cochern, ⁽³⁷⁾.

RESULTS

The oral administration of clove oil (150 mg/kg b wt) for 21 consecutive days induced non-significant changes in GSH, SOD, catalase, MDA, cholesterol, triglycerides, LDL, FSH, LH and testosterone (Tables 1, 2 and 3).

As shown in Table (1) the results obtained from rats exposed to single whole body irradiation (6.5Gy) are characterized by significant decrease in blood GSH content, catalase activity and SOD activity and is accompanied by significant increase in blood MDA level, 1 and 7 days post exposure, compared to control group. Supplementation of clove oil to rats pre-irradiation has significantly increased GSH content, catalase activity and SOD activity and significantly decreased MDA level 1 and 7 days post irradiation, compared to irradiated group.

Table (1): Effect of clove oil (150mg/kg b.wt) on blood glutathione (GSH) content, superoxide dismutase (SOD) catalase activity and malondialdehyde (MDA) level in different animal groups.

Groups	Days	GSH (mg/dl)	SOD (U/ml)	Catalase (U/ml)	MDA (mmol/L)
Control	1 st	55.23±2.48	6.59±0.22	50.05±2.56	161.90±1.73
	7 th	56.56±2.73	6.61±0.18	51.31±2.61	163.062±1.59
Clove oil	1 st	56.98±2.06 3.17%	6.71±0.21 1.82	51.20±2.40 2.30	159.23±2.71 -1.65
	7 th	54.81±1.60 3.09	6.18±0.18 -6.51	53.14±2.92 3.57	161.01±2.14 -1.26
Irradiated	1 st	40.32±2.08* -27	5.32±0.12* -19.27	42.35±1.03* -15.38	184.38±3.67* 13.89
	7 th	38.07±1.68* -30.54	5.18±0.15* -16.18	40.42±2.83* -23.93	186.25±2.81* 15.68
Clove oil +Irradiation	1 st	53.55±1.25# -6.02	6.34±0.15# -5.51	47.54±2.64# -7.15	164.74±3.60# 3.46
	7 th	51.99±2.25# -8.08	6.10±0.18# -7.72	51.56±2.66# 0.49	162.29±2.82# -0.47

The % change of control.

Each value represents the mean of 6 observations ± S.E.

* Significantly different from control values.

Significantly different from the values of irradiated rats.

Table (2) showed a significant increase in cholesterol, triglycerides and LDL levels after exposure to irradiation (6.5 Gy) on the 1st and 7th day, compared to control group. Significant amelioration was observed in animals orally administered clove oil for 21 days pre- exposure to irradiation, compared to irradiated group.

Table (2): Effect of clove oil (150 mg/kg b.wt) on serum cholesterol, triglycerides and Low density lipoprotein cholesterol (LDL) in different animal groups.

Groups	Days	Cholesterol (mg/dl)	Triglycerides (mg/dl)	LDL (mg/dl)
Control	1 st	54.34±0.61	102.74±1.50	27.82±0.30
	7 th	55.14±0.81	103.84±1.60	27.62±0.19
Clove oil	1 st	55.22±1.24 1.62	101.18±1.180 -1.52	28.11±0.89 1.04
	7 th	56.14±2.14 1.81	105.77±1.62 1.86	27.89±0.22 1.01
Radiation	1 st	82.38±1.54* 51.60	152.95±2.23* 48.87	38.28±0.38* 37.60
	7 th	81.66±2.39* 48.10	162.63±4.46* 56.62	39.02±0.63* 41.27
Clove oil + Radiation	1 st	56.27±0.95# 3.55	105.02±3.89# 2.22	29.46±1.04# 5.90
	7 th	57.01±1.35# 3.39	108.87±3.34# 4.84	30.00±1.23# 8.62

The % change of control.

Each value represents the mean of 6 observations ± S.E.

* Significantly different from control values.

Significantly different from the values of irradiated rats.

Table (3) showed a significant increase in FSH while a significant decrease in LH and testosterone hormone after exposure to irradiation, compared to control group. The supplementation of rats with clove oil for 21 days before irradiation induced significant decrease in FSH and a significant increase in LH and testosterone hormone, compared to their corresponding values in irradiated rats.

Table (3): Effect of clove oil (150 mg/kg b.wt.) on serum FSH, LH and testosterone hormones in irradiated rats.

Groups	Days	FSH(mIU/ml)	LH(mIU/ml)	Testosterone (mg/ml)
Control	1 st	3.25±0.09	1.32±0.06	3.21±0.05
	7 th	3.28±0.09	1.36±0.06	3.18±0.05
Clove oil	1 st	3.50±0.13	1.38±0.03	3.48±0.12
		7.69	4.55	8.41
% change	7 th	3.65±0.22	1.33±0.06	3.36±0.10
		11.28	-2.21	5.66
Radiation	1 st	6.24±0.40*	0.64±0.09*	1.64±0.14*
		92	-51.52	-48.91
% change	7 th	5.10±0.39*	0.57±0.09*	1.54±0.16*
		55.48	-58.09	-51.57
Clove oil+Radiation	1 st	3.89±0.39#	1.25±0.09#	3.22±0.18#
		19.69	-5.30	0.31
% change	7 th	3.56±0.39#	1.24±0.11#	3.05±0.13#
		8.54	-8.82	-4.08

The % change of control.

Each value represents the mean of 12 observations ± S.E.

* Significantly different from control values.

Significantly different from the values of irradiated rats.

DISCUSSION

A deleterious effect of radiation is the production of reactive oxygen species ROS, which result in damage to biomolecules (e.g. lipid, protein, amino acids and DNA) ⁽³⁸⁾ and finally leads to many diseases. The over production of ROS results in oxidative stress: defined as the imbalance between pro-oxidation and antioxidants. As a result of this imbalance, a chain of lipid peroxidation is initiated; this induced cellular damage ⁽³⁹⁾. Antioxidant compounds may function as free radical scavengers, reducing agents and quenchers of singlet oxygen formation. Phenolic compounds and flavonoids are major constituents of most of the plants reported to possess antioxidant and free radical scavenging activity ⁽⁴⁰⁾.

In the present study exposure of rats to gamma irradiation (6.5 Gy) resulted in marked significant elevation in lipid peroxides which was demonstrated by increased MDA level accompanied with depression in the antioxidant system (glutathione content superoxide dismutase and catalase enzymes). Zhang, *et al.* ⁽⁴¹⁾ and Chen, *et al.* ⁽⁴²⁾ attributed the elevation in lipid peroxides contents to the peroxidation of the membrane unsaturated fatty acids

due to free radical propagation concomitant with inhibition of bio-oxidative activities.

Our results are in accordance with Marcillo, *et al.* ⁽⁴³⁾ who reported that ionizing radiation induced excessive production of free radicals, enhances oxidative stress processes, which is associated with significant decrease in the oxidant status and accompanied by depleted antioxidant defensive system.

It was reported that free radicals formed by irradiation enhance lipid peroxidation and increase cytoplasmic membrane permeability to organic substances including enzymes ⁽⁴⁴⁾, data of our results are in accordance with Zahran, *et al.* ⁽⁴⁵⁾ at 6.5Gy. GSH function to scavenge cellular oxygen radicals and help detoxification by conjugation with free radicals ⁽⁴⁶⁾. Therefore, the decline in GSH has often been considered to be indicative of increased oxidative stress and thus result in tissue damage ⁽⁴⁷⁾. The decrease in GSH could be due to inactivation of glucose 6-phosphate dehydrogenase, the main NADPH+H supplier essential for its activity ⁽⁴⁸⁾.

The decrease in SOD activity may result in an increased flux of super oxide in cellular compartments which may be the reason for the increased in MDA in our study. Clove has been reported to possess a potent antioxidant activity, which reduces the oxidative stress in the body ⁽¹⁹⁾. Many investigators demonstrated the hepatoprotective properties of clove against chemical stress ⁽¹⁰⁾ and against physical stress ⁽¹¹⁾.

Administration of clove oil (150mg/kg b.wt.) to rats exposed to irradiation (6.5 Gy) result in significant amelioration in blood antioxidation status, these results are in agreement with Souza, *et al.* ⁽⁴⁹⁾ and Ashu, *et al.* ⁽⁵⁰⁾, they stated that eugenol is a nontoxic, highly hepatoprotective agent, induce glutathione s-transferase and thereby it may facilitate the removal of toxic substance from the intestine, predominately due to its free radicals quenching ability ⁽⁵¹⁻⁵²⁾ suggested that phenolic and allyl groups in eugenol structure and related components may inhibit lipid peroxidation at the level of initiation or at the level of propagation of free radical chain reaction like alpha tocopherol. Yadav and Bhatngar, ⁽²²⁾ reported that clove oil has modulatory effect on iron-induced lipid peroxidation due to their polyphenolic contents, strong reducing power and superoxide radical scavenging activity, preventing the generation of ROS. Our results are also in agreement with Said, ⁽⁵³⁾ who reported that eugenol decrease lipid and oxidative stress as well as improve intracellular antioxidant defense. Lee and Shibamoto, ⁽⁵⁴⁾ identified some aroma

chemicals such as eugenol, thymole and benzyl alcohol in the clove buds extract and examined them for their inhibitory effect on MDA formation. Clove aroma compounds exhibited the most potent antioxidant activities in suppression of lipid peroxidation.

Free radical impairs liver functions and can be a major reason of hormonal imbalance. This imbalance induces hyperlipidemia through its multiple effects on lipid metabolism, including increased synthesis of cholesterol and triglycerides⁽⁵⁵⁾.

Cholesterol is derived from exogenous diet and endogenously from acetyl Co A in a series of biosynthesis reaction⁽⁵⁶⁾, hypercholesterolemia is attributed to the increase of activation of HMG CoA reductase enzyme, the key regulatory enzyme in the reduction of the overall process of cholesterol synthesis⁽⁵⁷⁾.

Results of the present study revealed increase in cholesterol, LDL and triglycerides serum levels in the irradiated rat on the 1st and 7th day post irradiation (6.5 Gy). This increase may be due to the stimulation of the liver enzymes responsible for the biosynthesis of fatty acids by gamma irradiation and to the mobilization of fat from adipose tissue to the blood stream leading to a hyperlipidemic state associated with elevation in LDL. The elevation could be attributed to an alteration of fatty acids in plasma⁽⁵⁸⁾. The current results showed a significant decrease in serum total cholesterol, LDL and triglycerides in rats treated with clove oil, these results are in agreement with **Teissedre, and Waterhouse**,⁽⁵⁹⁾ and Ragab,⁽¹⁰⁾ they reported that eugenol inhibit in vitro oxidation of LDL + VLDL lipoprotein fractions isolated from rat plasma similar to the standard synthetic antioxidant butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA). Clove oil might lower the plasma free fatty acid, TG and cholesterol levels, and simultaneously reduced the hepatic fatty acid oxidation. These changes were seemingly attributed to a suppression of the hepatic fatty acid synthase, glucose-6-phosphate dehydrogenase and also it may have been partly due to the decreased hepatic-3-hydroxy-3-methyl glutaryl Co-enzyme (HMG CoA) reductase and acyl CoA: cholesterol acyl transferase (ACAT) activities as previously mentioned by Younies,⁽⁶⁰⁾ who reported that clove oil improved the levels of cholesterol, TG and phospholipids in serum of hyperlipidemic rats.

Oxidative damage, elevated lipid peroxidation and the alteration of membrane properties can lead to germ cell death at different stages of

development and a decrease in the sperm count, the antioxidant therapy will act as a protective defense against oxidative stress and improve fertility parameters⁽⁶¹⁾. FSH aids in spermatogenesis or the production of sperms, FSH disorder may cause infertility and sexual dysfunctions. LH deficiencies cause sexual disinterest and low sperm count because of a lack of testosterone⁽⁶²⁾.

In the current study, the significant increase in serum FSH in rats exposed to 6.5 Gy gamma irradiation post exposure might be attributed to disturbance inhibin of a peptide hormone produced by testicular tubules which acts by negative feedback mechanism to modulate the secretion production mechanism⁽⁶³⁾. On the other hand, the present data showed that gamma radiation induced a significant decrease in LH 1 and 7 days post exposure of irradiation, this may be due to damage in Leyding cells where luteinizing hormone releasing hormone (LHRH) receptors are located⁽⁶⁴⁾.

Testosterone is a steroid hormone from the androgen group. In men, testosterone plays a key role in the development of male reproductive tissues such as the testis and prostate as well as promoting secondary sexual characteristics such as increased muscle, bone mass and hair growth⁽⁶⁵⁾. In addition, testosterone is essential for health⁽⁶⁶⁾. In the present work, whole body gamma irradiation at a dose level of 6.5 Gy induced a decrease in the serum level of testosterone, the data comes in accordance with Varga,⁽⁶⁷⁾ who recorded decrease in plasma levels of testosterone after exposure to 3 Gy X-ray. Mc Taggart and Wills,⁽⁶⁸⁾ said that gamma radiation to whole body, head or lower trunk region causes a fall in the circulating levels of testosterone and LH, they said that whole body radiation causes inhibition of the liver enzymes by a complex of interrelated effects the testis, anterior pituitary and possibly hypothalamus, the secretion of testosterone is under the control of hormones of the anterior pituitary and especially LH. In the present study, treated rats with clove oil pre-exposure to irradiation resulted in an improvement in the FSH, LH and testosterone hormones, these findings are supported by Tajuddin⁽⁶⁹⁾ who indicated that the 50% ethanolic extract of clove produced a significant and sustained increase in the sexual activity of normal male rats, without gastric ulceration and adverse effects. Thus the resultant aphrodisiac effectivity of the extract lends support claims for its traditional usage in sexual disorders.

From our results, clove oil has the ability to stimulate the body self defense mechanisms against oxidative stress induced by radiation and increased antioxidant status by scavenging free radicals, inhibit lipid peroxidation which

lead to improvement in the cell membranes resulted in hepatoprotective and genital protective properties in male albino rats.

REFERENCES

1. Yu J.; Piao BK.; Pei YX.; Qi X. and Hua BJ. (2010): Protective effects of tetrahydropalmatine against gamma-radiation induced damage to human endothelial cells. *Life Sci.*, 3; 87 (1-2):55-63.
2. Veremeyeva, G.; Akushevich I.; Pochukhailova T.; Blinova E.; Varfolomeyeva T.; Ploshchanskaya O.; Khudyakova O.; Vozilova A.; Kozionova O. and Akleyev, A.(2010) Long-term cellular effects in humans chronically exposed to ionizing radiation. *Health Phys.*, 99 (3):337-46.
3. Fu, L.; Xu, BT.; Xu ,XR.; Qin, XS.; Gan, RY.; Li, HB.(2010): Antioxidant capacities and total phenolic contents of 56 wild fruits from South China. *Molecules J.* 29; 15(12):8602-17.
4. Turner, N.D. and Brady, L.A. (2002): Opportunities for nutritional amelioration of radiation- induced cellular damage. *Nutrition*, 18(10): 904-921.
5. Henning, SM.; Zhang Y.; Seeram NP.; Lee RP.; Wang P.; Bowerman S and Heber D. (2011) Antioxidant capacity and phytochemical content of herbs and spices in dry, fresh and blended herb paste form. *Int. J. Food Sci. Nutr.*, 62(3):219-25.
6. Stich, FD and Smith, RM. (2010): Eugenol: some pharmacologic observation. *Journal of Dental Research*, 50(6): 1531-1535.
7. Schmid, R. (1972): A resolution of *Eugenia- syzygium* controversy (Myrtaceae) Amer. J. Bot. 59(4): 423-436.
8. Rajalakshmi, K.; Gurumurthi, P. and Devaraj, S.N. (2000): Effect of eugenol and tincture of crataegus(TCR) on in vitro oxidation of LDL+VLDL isolated from plasma of non –insulin dependent diabetic patients. *Indian J. Biol.* 38 (5): 509-511.
9. Cortran, R.S.; Kumar, V. and Robbins, C.T. (2000): Pathologic Basis of Disease. 6th ed. Pennsylvaniv. Saunders, 300.
10. EL- Segaeey. O.; Abd-Allah A. and Abou-Alnooman. S. (2007): Experimental study of antioxidant and hepatoprotective effect of clove and cardamom in ethanol induced hepatotoxicity. *Tanta Medical*

Science Journal, 2(1): 27-36.

11. Ragab, E.A. (2008): The possible role of eugenol in counteracting radio-oxidative damage in mice. *Egypt. J. Rad. Sci. Applic.*, 21(1): 19.
12. Khan, MA. (1993): Qaranful (clove). In: Khan MA, editor. Moheet-e-Azam (Persian). III. Kanpur, India. *Matba Nizami*; 296.
13. Nadkarni, KM. (2000): *Myrtus caryophyllus*. In: Nadkarni AK, editor. Materia Medica. Mumbai, India. *Popular Prakashan* (Pvt. Ltd); 835–836.
14. Pourgholami MH, Kamalinejad M, Javadi M, Majzoub S and Sayyah M. (1999): Evaluation of the anticonvulsant activity of the essential oil of *Eugenia caryophyllata* in male mice. *J. Ethnopharmacol.*, 64:167–171.
15. Baytar, I. (1869): Qaranful (clove). In: Baytar Ibn, editor. Al Jame' Li-Mufradat al Advia wal Aghzia (Arabic). IV. Cairo, Egypt. *Matba Zahiyah Zaaheerah Mutawaffarah*; Pp. 7–9.
16. Raazi, ABM. (1961): Qaranful (clove). In: Raazi ABM, editor. In: Kitab al Haawi Fi al Tibb (Arabic). XXI. Hyderabad, India. *Daerah al Ma'arif*; 302.
17. Zheng, GQ. and Kenney PM. (1992): Sesquiterpenes from clove (*Eugenia caryophyllata*) as potential anti carcinogenic agents. *J. Nat. Prod.*, 55: 999–1003.
18. Srivastava, KC. and Malhotra, N. (2001): Acetyl eugenol, a component of oil of cloves (*S. aromaticum*) inhibits aggregation and alters arachidonic acid metabolism in human blood platelets. *Prostaglandins Leukot Essent. Fatty Acids.*, 42:73–78.
19. Chaieb, K.; Hajlaoui, H. and Zmantar, T. (2007): The chemical composition and biological activity of clove essential oil, *Eugenia Caryophyllata* (*Zyzigium aromaticum* L. Myrtaceae). A short review. *Phytotherapy Res.*, 21; 501-506.
20. Misharina, T.A. and Samusenko, A.L. (2008): Antioxidant properties of essential oils from lemon, grape fruit, coriander, clove and their mixtures. *Prikl. Biokhim. Mikrobiol.*, 44(4); 482-6.
21. Wang, H.F.; Wang, Y.K. and Yih, K.H. (2008): DPPH free radical scavenging ability, total phenolic content and chemical composition analysis of forty five kinds of essential oils. *J. Cosmet. Sci.*, 59(6): 509-22.

22. Yadav, A.S. and Bhatnagar, D. (2007) Modulatory effect of spice extracts on iron- induced lipid peroxidation in rat liver. *Biofactors*, 29(2-3): 147-57.
23. Nangle, M.R.; Gibson, T.M. Cotter, M.A. and Cameron, N.E. (2006): Effects of eugenol on nerve and vascular dysfunction in streptozotocin diabetic rats. *Planta Med.*, 72(6): 494-500.
24. Dearlove, R.P.; Greenspan, P. Hartle, D.K.; Swanson, R.B. and Hargrove, J.L. (2008): Inhibition of protein glycation by extracts of culinary herbs and spices. *J. Med. Food*, 11(2): 275-81.
25. Santin JR.; Lemos M.; Klein-Júnior LC.; Machado ID.; Costa P.; de Oliveira AP.; Tilia C.; de Souza JP.; de Sousa JP.; Bastos JK. and de Andrade, SF. (2011): Gastroprotective activity of essential oil of the *Syzygium aromaticum* and its major component eugenol in different animal models. *Naunyn Schmiedebergs Arch Pharmacol.*;383(2):149-58.
26. Kumarvelu, P., Subramanyam, S., Dakshin, Murthy DP., Devraj NS. and Kumarvelu, P. (1996): The effect of eugenol on carbon tetrachloride-induced erythrocyte damage in rats. *Nut Biochem.*, 7: 23–28.
27. Kirsche, M. (1990): Non cardiogenic pulmonary edema due to the intravenous administration of clove oil. *Thorax*. 45(3): 235-236.
28. Beulter, E., Duran, O. and Mikus-Kelly, B. (1963): Improved method for the determination of blood glutathione. *J.lab. Clin. Med.*, 61(5): 882.
29. Minami, M. and Yoshikawa, H. (1979): A simplified assay method of superoxide dismutase activity for clinical use. *Clinica chemical Acta*, 92, 338.
30. Bergmeyer, H.U.; Bergmeyer, J. and Grabl, M. (1987) In: Methods of Enzymatic Analysis, 3rd ed. USA and Canda, 273, VSH Publishers
31. Yoshioka, T.; Kawada, K.; Shimada, T. and Mori, M. (1979): Lipid peroxidation in maternal and cord blood and protective mechanism against activated oxygen toxicity in blood. *Am. J. Obstet. Gynecol.*, 35, 372.
32. Garrett, PE. (1989): The enigma of standardization for LH and FSH assays. *J. Clin. Immunoassay*. 12(1), 18.
33. Wilson, JD. and Foster, DW. (1992): Williams Textbook of

Endocrinology. Philadelphia: Saunders, 923-926.

34. Allain, C.; Poon, L.; Chan, C.R.; Richmoud, W. and Fu, P. (1974): Enzymatic determination of total cholesterol. *Clin. Chim.*, 20 (4): 470.
35. Demacker, P.N.M.; Vos-Janssen, H.E.; Hifman, A.G.; Vant's Lear, A. and Jansen, A.P. (1980): Measurement of high density lipoprotein cholesterol in serum: Comparison of six isolation methods combined with enzymatic cholesterol analysis. *Clin. Chem.*, 26: 1780.
36. Fossati, P. and Prencipe, L. (1982): Enzymatic determinationn of triglycerides. *Clin. Chem.*, 28, 2077.
37. Snedecor, G.W. and Cochern, W.G. (1989): Statistical Methods of 8th ed., Louis state, University, USA.
38. Guseva, DA.; Sanzhakov, MA.; Shironin, AV. and Prozorovskaia, NN. (2010): Anti-radical activity and oxidative stability of oils manufactured from flax, sesame and silybum seeds. *Vopr. Pitan.*, 79(4):4-8.
39. Dasgupta, A., Mathtra,D., Levy, H. Marcadis, D., Blackwell, W. and Johnston, D. (1997): Decrease total antioxidant capacity but normal lipid concentration in plasma of critically ill patients. *Life Sci.*, 60 (4-5): 335.
40. Satheesh, kumar D.; Kottai, Muthu A.; Anton Smith, A. and Manavalan R. (2010): Free radical scavenging activityof various extracts of whole plant of *Mucuna pruriens* (Linn): An in-vitro evaluation. *Journal of Pharmacy*, 3(4); 718-721.
41. Zhang, H.; Zhuo, L.; Chen, R. and Chen, X. (1996): Bio-oxidase activities in cytoplasm of mouse blood and liver cells. *Chin. J. Med. Prot.*, 16(3): 179.
42. Chen, X.; Luo, X. and Zhol, L. (1997): Radioprotective effect of recombination human Cu-Zn SOD on activities of antioxidases and immunocyte in irradiated mice. *Clin. J. Rad. Med. Prot.*, 17: 267.
43. Marcillo, M. A., Rucandio, M. I. and Santamaria, J. (2000): Effect of gamma irradiation on liver metallothionein synthesis and lipid peroxidation in rats. *Cell. Mol. Biol.*, 46(2): 435.
44. Barni, C.; Lungarcella, G. and Fonzi, L. (1980): Response of lung enzyme activities in rabbits following short term exposure to n- hexane correlation between morphological and biochemical changes. *Agents Action*, 12, 737-757.

45. Zahran, A.M.; Noaman, E.; Omran, M. F. and Said, K. (2003): Influence of some micronutrients quenching the effect of gamma radiation on plasma and vitamin E content in rats. *Egypt. J. Rad. Sci. Applic.*, 16(1): 71.
46. Nauser, T.; Koppenol, W.H. and Gebicki, J.M. (2005): The kinetics of oxidation of GSH by protein radicals. *Biochem J.* 15; 392(Pt 3): 693–701.
47. Andreoli, S.P.; Mallett, C.P. and Bergstein, J.M. (1986): Role of glutathione in protecting endothelial cells against hydrogen peroxide oxidant injury. *J. Lab. Clin. Med.* 108, 190.
48. Williams, A. and Ford, W. (2004): Functional significance of pentose phosphate pathway and glutathione reductase in the antioxidant defenses of human sperm. *Biology of Reproduction* 7: 1309-1316.
49. Souza, M.F.; Tome, A.R. and Rao, V.S. (1999): Inhibition by bioflavoids ternation of aflatoxin B1- induced lipid peroxidation in rat liver. *J. Pharm. Pharmacol.*, 51(2): 125.
50. Ashu, B.; Tikur, S. K.; Abraham and Raosaheb, K. (2004): Eugenol as an in vivo radioprotective agent. *J. Radiat. Res.*, 45(3): 435-40.
51. Nagababu, E. and Lakshmaiah, N. (1994): Inhibition of microsomal lipid peroxidation and monooxygenase activities by eugenol. *Free Radic. Res.*, 20(40): 353.
52. Ogata, M.; Hosi, M.; Urano, S. and Endo, T. (2000): Antioxidant activity of eugenol and related monomeric and dimeric compounds. *Chem. Pharm. Bull.*, 48(10): 1467.
53. Said, MM. (2010): The protective effect of eugenol against gentamicin-induced nephrotoxicity and oxidative damage in rat kidney. *Fundam Clin. Pharmacol.*, 24. Doi: [Epub ahead of print]
54. Lee, K.G. and Shibamoto, T. (2001): Inhibitory of malonaldehyde formation from blood plasma oxidant by aroma extracts and aroma components isolated from clove and eucalyptus. *Food Chem. Toxicol.*, 39(12): 1199-204.
55. Bowden, D. A.; McLean, P.; Steinmetz, A.; Fontana, D.; Matthys, C.; Warnick, G. R.; Cheung, M.; Albers, J. and Hazzard. W. (1989): Lipoprotein, apolipoprotein and lipolytic enzyme changes following estrogen administration in post menopausal women. *J. Lipid Res.*, 30: 1895-1906.

56. Garcia, M.; Bayon, D.; Culebras, F.; Jorquera, P. and Garcia, D. (1996): Hepatic metabolism of cholesterol. *Nutr. Hosp.*, 11(1): 37.
57. Bok, S.; Lee, S.; Park, Y.; Bae, K.; Son, K.; Joong, T. and Choi, M. (1999): Plasma and hepatic cholesterol and hepatic activities of 3-methyl- glutaryl-Co A reductase and acyl Co A; cholesterol transferase are lower in rats fed citrus peel extracts or a mixture of citrus bioflavonids. *J. Nutrition*, 129, 1182.
58. El-Ghazaly, M. and Ramadan, L. (1996): Alterations in some metabolic functions in albino rats after irradiation and possible role of thiola. *J. Egypt. Soc. Toxicol.*, 16, 105.
59. Teissedre, P. L. and Waterhouse, A. L. (2000): Inhibition of oxidation of human low- lipoprotein by phenolic substances in different essential oils varieties. *J. Agric. Food Chem.*, 48 (9): 3801.
60. Younies, B.M. (2008): Effect of the aqueous extract of cloves (*Syzygium aromaticum*) on hyperlipidemia in senile rats. *J. Rad. Res. Appl. Sci.*, 1(1): 53-63.
61. Acharya, UR. ; Mishra, M. ; Patro, J. and Panda MK. (2008): Effect of vitamins C and E on spermatogenesis in mice exposed to cadmium. *Reprod. Toxicol.*, 25: 84-88.
62. Sadhnani M.D., Ramesh Babu S., Swarna, M. Padmavathi P. and Reddy P.P. (2004): Evaluation of FSH, LH and testosterone levels in different subgroups of infertile males. *Indian Journal of Clinical Biochemistry.*, 19(1): 45-49
63. Green, J. D. and Harris, G.W. (1978): Observation of hypophysiportal vessels of the living rat. *J. Physiol. (London)* 108-359.
64. Bain, J. and Knee, J. (1975): Further evidence for inhbin: Changes in serum luteinizing hormone and follicle stimulating hormone levels after x- irradiation of rat testes. *J. Endocrinol.*, 66, 278-280.
65. Mooradian, AD., Morley, JE. and Korenman, SG. (1987): "Biological actions of androgens". *Endocr. Rev.* 8 (1): 1–28.
66. Bassil, N.; Alkaade, S. and Morley, JE. (2009): "The benefits and risks of testosterone replacement therapy: a review". *Ther Clin. Risk Manag.*, 5 (3): 427–48
67. Varga, S.V.; Sinitsyn, P.V.; Tarasenko, L.V.; Chajkovskaya, L.V. and Reznikov, A.G. (1993): Functional activity of hypothalamo hypophsis

gonade system in rat males at later times after X irradiation. *Radiatsionnaya Biologiya*, 33(3): 337-341.

68. McTaggart J. and Wills E.D. (1977): The effect of whole body and partial body irradiation on circulating anterior pituitary hormones and testosterone and the relationship of these hormones to drug metabolizing enzymes in the liver. *Rad. Res.*, (72): 122-133.
 69. Tajuddin, AS., Latif, A. and Qasmi, IA. (2003): Aphrodisiac activity of 50% ethanolic extracts of *Myristica fragrans* Houtt. (nutmeg) and *Syzygium aromaticum* (L.) Merr. & Perry. (Clove) in male mice: a comparative study. *BMC Complement Altern. Med.*, 3:6.
-



مجلة البحوث الإشعاعية والعلوم التطبيقية

مجلد ٤ عدد ٣ (ب) ص ص ٩٣٩ – ٩٥٥ (٢٠١١)

فاعلية زيت القرنفل كمضاد للأكسده ضد مخاطر الإشعاع في ذكور الجرذان

ناديه عبد المجيد عبد الفتاح وأمال غريب أحمد

قسم بحوث بيولوجيا الإشعاع - المركز القومي لبحوث وتكنولوجيا الإشعاع هيئة الطاقة الذرية - مصر - القاهرة

تهدف الدراسة الي تقييم فاعليه تجريع زيت القرنفل وذلك لمدة ٢١ يوم علي التوالي بجرعه مقدارها ١٥٠ مللي جرام/كجم من وزن الجرذ ولتحقيق ذلك تضمنت هذه الدراسة عدد (٤٨) من ذكور الجرذان البيضاء التي يتراوح وزنها من ١٢٠-١٥٠ جرام وقسمت إلى أربع مجموعات وتحتوي كل مجموعة على (١٢ جرذ): المجموعة الأولى/ جرذان المجموعة الضابطة، المجموعة الثانية/جرذان تم معالجتها عن طريق الفم بزيت نبات القرنفل (١٥٠ مللي جرام/كجم) لمدة ٢١ يوما متتالية ، المجموعة الثالثة جرذان تم تعرضها إلى جرعة مفردة من أشعة جاما (٦.٥ جراى) والمجموعة الرابعة/ جرذان تمت معالجتها بزيت نبات القرنفل (١٥٠ مللي جرام/كجم) لمدة ٢١ يوما ثم تم تعرضها لأشعة جاما (٦.٥ جراى). وقد تم قياس كلا من محتوى الجلوتاثيون ، نشاط (انزيم السوبر أكسيد الديسموتيز، إنزيم الكاتاليز)، المألوناداهيد في الدم، مستوى المحتوي الكلي للكلوستيرول ، الجلوسيريدات الثلاثيه ، LDL وهرمونات FSH ، LH والتستستيرون. وتشير النتائج إلى أن الجرذان التي تعرضت للإشعاع (٦.٥ جراى) قد أظهرت ارتفاعاً ملحوظاً في مستوى المألوناداهيد يصاحبه نقص في مستوى مضادات الأكسده، والمحتوي الكلي للكلوستيرول، والجلسيرات الثلاثيه و LDL وهرمون FSH، بينما لوحظ نقص هرمون التستستيرون وهرمون LH علي اليوم الأول والسابع من التشيع وتبعاً لنتائج الدراسة فقد اظهر اعطاء زيت القرنفل (١٥٠ مللي جرام/كجم) قبل التعرض للإشعاع تحسن ذات دلالة احصائية في القياسات السابق ذكرها. ولهذا تؤكد الدراسة أهميه زيت القرنفل كمركب طبيعي لتخفيف الإجهاد التأكسدي والتخلص من الشقائق الحرة الناتجة عن التعرض للإشعاع.