Journal of Radiation Research and Applied Sciences

J. Rad. Res. Appl. Sci., Vol. 4, No. 4(A), pp. 1201 – 1219 (2011)

Antioxidant Effects of *Ferula Hermonis* and Bee Honey on γ -Radiation-Induced Oxidative Testicular Damage in Rats

Osman, N. N.

Food Irradiation Research Dep. National Center for Radiation Research and Technology, Atomic Energy Authority, Cairo, Egypt
E-mail: dr_nadia_nour@yahoo.com
Received: 22/ 08/2011. *Accepted: 23/10/2011.*

ABSTRACT

Ionizing radiation is one of the environmental factors that may contribute to reproductive dysfunction by a mechanism involving oxidative stress. The present investigation was undertaken to study the possible protective effect of *Ferula hermonis* (FH), bee honey (BH) or mixture of both on whole body gamma irradiation induced testicular toxicity in rats. The study consisted of five groups of 6 rats each. Group 1 (control), whereas group 2 received a single dose of γ-radiation (8Gy). The animals in groups 3-5 were pretreated with FH (3mg/kg), BH (1.5 ml/ Kg) and their combination by oral gavages, respectively for ten consecutive days prior to and twenty days after exposure to γ-radiation. Gamma-irradiation of rats resulted in a significant ($p<0.05$) decrease in testis weight, serum testosterone(T), follicle stimulating hormone (FSH) and luteinizing hormone (LH) levels . Testicular enzymes such as alkaline phosphatase (ALP), lactate dehydrogenase (LDH) were significantly decreased, while acid phosphatase (ACP) was significantly increased. Also, gamma irradiation of animals significantly ($p<0.05$) decreased the activity of superoxide dismutase, catalase as well as glutathione enzyme. These effects were accompanied by a significant elevation of testicular lipid peroxidation.

The results revealed that FH and/or BH possess a significant protective potential against irradiation induced testicular damage. They normalized the weight reduction in testis. In addition, they restored the antioxidant testicular activities, antagonized the significant changes in ALP, LDH, ACP and restored the serum level of T, FSH and LH.

Therefore, the present results revealed that FH and /or BH may have a protective effect against gamma irradiation-induced testicular dysfunction by antagonizing the free radicals generation and enhancement of the antioxidant defense mechanisms.

Keywords: Gamma irradiation, Testicular dysfunction, Oxidative stress, Ferula hermonis, Bee honey, Rats..

INTRODUCTION

With the development of nuclear technique, human beings are facing more dangerous effects of using ionizing radiation in different aspects of modern life than before [(1)]. Ionizing radiation inflicts its adverse effects through the generation of oxidative stress that unleash large-scale destruction or damage of various biomolecules. Oxidative stress mechanisms are involved in xenobiotic-induced testicular dysfunctions which may lead to male infertility [(2, 3)]. Under normal conditions, the testis is afforded with antioxidant protection as an elaborate array of antioxidant enzymes, free radical scavengers, and low oxygen tension in order to support the well as Leydig cells steroidogenic function [(4)]. However, a wide variety of endogenous and exogenous factors are known to perturb these defenses and compromise male fertility by generating free radicals in testes [(5, 6)]. In order to prevent and relieve the hazard to human reproductive health induced by ionizing radiation exposure, avoid the toxicity and the side effects and for the labilization of anti-radiation drugs [(7)]. Therefore, seeking for radioprotectors derived, from traditional foods and medicinal plant sources, is worthy to receive great attention and special consideration.

Today, it is estimated that about 80% of the world population relies on botanical preparations as medicine to meet their health needs [(8)]. Among the Medicinal plants is *Ferula hermonis*, in Arabic words, Shirsh Zallouh "hairyroot", is a plant with thin leaves and little white or yellowish flowers belonging to the *Umbellifera*e family. Its roots are ingested either after being soaked in wine or as a liquid solution, or ground into powder and made into capsules or mixed with tea or honey. Commercially it is marketed as a natural product under the name of "sex roots", and is believed to be more powerful than Viagra, producing its effect within 30 minutes from the time of uptake without any side effects [(9)].

Honey is a natural substance produced by honey bees from nectar or blossoms or from the secretion of living parts of plants or excretions of plants

[10]. It is a highly nutritious material as it is considered a balanced food source [11]. Honey is a natural product with very complex chemical composition. It is composed primarily of fructose and glucose but also contains 4 to 5% fructooligosaccharides which serve as prebiotic agents. It contains more than 180 substances, including amino acids, vitamins, minerals and enzymes [12].

Although it is very well known as a food, honey is not well recognized as a medicine, yet it is one of the oldest medicines known and has continued to be used as such through the ages [13]. For a long time, it has been observed that honey is an antioxidant, anti-inflammatory and antitumor; possesses a considerable hydroxyl radicals scavenging activity and prevents the depletion of the antioxidant enzymes [14-17].

Accordingly, the present work was conducted for exploring the possibility of using *Ferula hermonis* roots and/or bee honey as protective supplements against gamma irradiation induced testicular toxicity in rats.

MATERIALS AND METHODS

The utilized substances were:

Roots of *Ferula hermonis* (FH) were obtained from the experimental station of medicinal plants, Ministry of Agriculture, Cairo, Egypt. The honey used was a pure commercial honey purchased from a local supermarket Cairo, Egypt.

Preparation of Ferula hermonis roots and honey for use

Plant roots were grounded and an aqueous extract was prepared by boiling the roots in water for 5 min. The weight of starting material was 60 g/L. Filtering the materials after 2-3 h and drying the filtrated extract on water bath to obtain 20 g of aqueous extract. The extract was stored; at -20°C and used within 24 h. The aqueous extract was freshly prepared in distilled water immediately before being given to animals at a concentration of 3 mg/kg in a total volume of 1.0 ml. Honey was diluted before use with distilled water on a weight/volume ratio of 1:4, i.e. 25g honey/ 100ml distilled water.

Animal and Housing

This study was carried out on 40 young male albino rats weighing 120-140 g obtained from the animal house of the National organization for Drug Control and Research. Rats were housed under controlled climatic conditions (25°C, 40–70 RH), and 12h/12h light/dark cycle prior to subjection to

experimental protocols. All rats were fed on a standard diet and water *ad libitum.* All animals were treated and handled according to the principles of laboratory animal care.

Irradiation:

Source of ionizing radiation used was Cobalt-60 gamma cell 3500. Whole-body Gamma-irradiation of rats was performed at the National Centre for Radiation Research and Technology (NCRRT), Cairo, Egypt. Animals were exposed to an acute single dose level of 8 Gy delivered at a dose rate of 1Gy/1.5 min.

Experimental Design:

At the beginning of the experiment, rats were divided into five groups (8 rats / group).

The 1st one was the untreated control group.
The 2nd group was whole body irradiated at a single dose of γ-radiation (8 Gy).
The 3rd, 4th and 5th groups were treated by oral administration with *Ferula hermonis* roots at 3mg/kg b.w (FH), bee honey at 1.5 ml/ Kg b.w (BH) and their combination, respectively, for ten consecutive days pre-exposure to γ-irradiation and twenty days after γ- irradiation.

After 20 days post-irradiation, rats were dissected under light anaesthesia and blood samples were collected by heart puncture using sterile syringes. Blood samples were incubated at 37°C then centrifuged to collect sera for reproductive hormone analysis using radio immunoassay technique. Testis was dissected out, weighed and then homogenate in cold physiological saline, then were used for testis biochemical analysis.

Biochemical analysis:

Frozen testis were washed with saline solution, then minced and homogenized (10% W/V) in ice-cold saline, using a chilled glassteflon porter-Elvehjem tissue grinder tube. The homogenate was centrifuged at 10,000 xg for 20 min. at 4°C and the resultant supernatant was used for the determination of alkaline phosphatase, ALP [18] and acid phosphatase ACP [19]. Also, a 10% homogenate of testis was prepared in ice-cold 0.1M phosphate buffer, the homogenate was centrifuged at 12,000 xg for 30 min. at 4°C. The supernatant was used for the determination of lactate dehydrogenase, LDH [20].

Hormonal assays:

The level of luteinizing hormone (LH) and follicle stimulating hormone

(FSH) were determined using radioimmunoassay (RIA) methods and followed the procedure instructions of the corresponding kits.

Serum testosterone (T) level was estimated using a test reagent kit based on a solid phase enzyme linked immunosorbent assay (ELISA) [21].

Oxidative stress measurements in testis:

Lipid peroxidation (LPO) in testis was estimated by measuring the formed thiobarbituric acid reactive substance (TBARS) [22]. Total superoxide dismutase (SOD) activity was determined using nitroblue tetrazolium and phenazine methosulfate [23]. Catalase (CAT) activity was assayed as suggested by Aebi [24]. The method is based on the rate of H_2O_2 degradation by the action of catalase contained in the examined samples. Glutathione (GSH) content in the testis was determined spectrophotometrically at 412 nm using 5,5%-dithiobis-2-nitrobenzoic acid [24].

Statistical analysis:

Data were analyzed using One-way analysis of variance ANOVA. The results obtained were expressed as means ± standard error of the mean. Differences were considered significant at $P<0.05$.

Results

As depicted in Table (1), the testicular weights were significantly ($p < 0.05$) decreased after exposure of rats to γ- radiation comared to control indicating testicular atrophy and damage. The significant reduction in testicular weights was dramatically normalized by administration of FH + BH.

Table (1): Effect of oral administration of FH and/ or BH on testicular weights of Irradiated rats

Groups	control	Irrad.	Irrad. +FH	Irrad. + BH	Irrad. +FH+BH
Testis Weight (g)	2.05 ± 0.07^{a}	1.32 ± 0.07^{c}	1.59 ± 0.04^{b}	1.70 ± 0.13^{ab}	1.93 ± 0.12^{a}

Data represent Means ± S.E

^{abc}Within rows, between control and treated animals, means with different superscript letters differ significantly ($P < 0.05$).

The data in Table (2) revealed a significant decrease ($p < 0.05$) in serum T, LH and FSH concentration after exposure of rats to γ-radiation. This decrease was improved in irradiated rats treated with FH and / or B H.

Table (2): Effect of FH and/ or B H on serum level of testosterone (T), luteinizing hormone (LH) and follicle stimulating hormone (FSH) in irradiated rats

Groups	T (n mol/L)	LH(IU/L)	FSH(IU/L)
Control	4.91±0.17[a]	0.93±0.14[a]	0.83±0.05[a]
Irrad.	2.56±0.13[b]	0.55±0.018[b]	0.65 ±0.06[b]
Irrad.+FH	4.71±0.15[a]	0.63±0.075[ab]	0.70±0.05[a]
Irrad.+ BH	4.10±0.13[ab]	0.69±0.023[ab]	0.73±0.06[a]
Irrad.+FH+BH	4.78±0.15[a]	0.72±0.03[ab]	0.76±0.06[a]

Data represent Means ± S.E.

[ab]Within columns, between control and treated animals, means with different superscript letters differ significantly (P < 0.05).

The testicular activity of ACP in irradiated rat group was significantly ($p < 0.05$) increased in comparison with that of control group. Co-administration of the two food additives significantly ameliorated the decreased enzyme activity to approximate the control level (Table 3). On the contrary, testicular ALP and LDH activity showed a significant decline in irradiated animals, Concomitant daily oral administration of each of FH and BH was found to cause significant restoration in these enzymes.

Table (3): Effect of FH and/or BH on testicular enzymes activity in irradiated rats

Goups	ACP (IU/mg)	ALP (IU/mg)	LDH (IU/g)
Control	11.21 ± 0.44[b]	635.12 ± 22.05[a]	1431 ± 67.13[a]
Irrad.	14.67 ± 1.01[a]	486.31 ± 19.25[b]	1063 ± 82.28[b]
Irrad.+FH	12.33 ± 0.56[b]	557.09± 67.34[ab]	1224 ±62.47[ab]
Irrad.+ BH	13.21 ± 0.51[ab]	542.92 ± 34.14[ab]	1315 ± 7.44[ab]
Irrad.+FH+BH	11.75±0.78[b]	597.68±27.54[ab]	1354±64.37[a]

Data represent Means ± S.E

[ab]Within columns, between control and treated animals, means with different superscript letters differ significantly (P < 0.05).

Data in table (4) revealed that there was a significant ($P<0.05$) increase in the level of testicular TBARS in animals exposed to gamma radiation compared with control group. Irradiated animals treated with FH, BH or with a mixture of both additives, showed a decrease of the TBARS level compared with irradiated group. On the contrary, testicular antioxidants which include SOD and CAT activities and GSH content were decreased significantly below the control values of the γ- irradiated treated rats (Table 4). These decrements in testicular antioxidants level were unpronounced when FH or/and BH was administered to rats pre and post γ- irradiation treatment (Table 4).

Table (4): Effect of FH and/or BH on the levels of testicular TBARS, SOD, CAT and GSH in rats exposed to γ- rays.

Groups	TBARS (nmol /g tissue)	SOD (U/g fresh tissue)	CAT (Unit /mg protein)	GSH (µmol /g tissue)
control	94.51±5.52^{c}	17.81±0.68^{a}	20.71±0.76^{a}	16.10±1.22^{a}
Irradiated	134.81±7.13^{a}	11.33±0.78^{c}	16.50±0.39^{c}	10.35±0.71^{c}
Irrad.+ FH	106.32±4.51^{bc}	13.71±0.81^{b}	18.73±0.74^{ab}	13.51±0.97^{ab}
Irrad.+ HB	112.30±3.07^{b}	14.11±0.28^{b}	17.82±0.45^{bc}	12.34±0.35^{bc}
Irrad. +FH+HB	100.21±3.91^{bc}	16.01±0.51^{a}	18.87±0.73^{ab}	14.16±0.83^{ab}

Data represent Means ± S.E.

^{abc}Within columns, between control and treated animals, means with different superscript letters differ significantly (P < 0.05).

DISCUSSION

The development of radioprotective agents is important for protecting patients from the side-effects of radiotherapy, as well as occupational workers in nuclear and radiation plants. Natural compounds have been evaluated as radioprotectors and seem that they exert their effect through antioxidants content and immunostimulant activities.

In the present study, a decrease in testicular weight after radiation exposure was noticed. This decrease may be due to the actual loss in the germinal epithelial cells and not reflected by changes in the interstitial tissue or Sertoli cells. Similar declining pattern in testicular weights and in weight index was also observed by Jagetia *et al*. [25] in lethally irradiated mice.

It is well known that T, FSH and LH are the major hormones in male animals and man, which play important roles in male reproduction. In male animals, T is produced by testis. The secretion of T is regulated by FSH and LH which were produced by adenohypophysis. FSH increases Sertoli cell synthesis of an androgen binding protein needed to maintain high concentrations of testosterone. LH stimulates testosterone production by the interstitial cells of the testis [26].

The present results indicated that whole body gamma irradiation of rats caused a dramatic decrease in serum T, FSH and LH levels. These finding are in accordance with those of Jegou *et al* [27] and Dygalo *et al* [28]. They reported that radiation has particularly severe adverse effect on gonads and therefore on fertility in both animals and man. Also, Said *et al*., [29] observed that exposure of rats to gamma radiation at 7Gy (single dose) significantly diminished the serum levels of

testosterone, luteinizing hormone (LH), follicle stimulating hormone (FSH).

Activity of markers enzymes viz ACP, ALP and LDH are considered to be functional indicators of spermatogenesis [30]. In the present investigation, the activity of ACP was found to increase significantly in the radiation group. Szeinfeld and Villiers [31] also observed a marked augmentation in acid phosphatase activity in irradiated testis. ACP has been detected in the acrosome of spermatozoa. Its presence has also been reported in the lysosome of Sertoli cells, spermatocytes, and spermatids [32]. Irradiation causes lipid peroxidation of lysosomal membrane. Thus, increased activity of acid phosphatase may be attributed to the breakdown of lysosomal membrane and liberation of the enzyme. This conclusion seems to agree with the findings of Samarth *et al*. [33].

A significant decline in ALP activity was also noticed in the irradiated group as compared to control. ALP is known to be associated with germinal cells [34]. It has been detected in the seminiferous tubule, basement membrane and interstitial cells. It plays a vital role in transport of material from Sertoli cells to various germinal cells, differentiation and proliferation of the germinal epithelium and in the testicular metabolism. Radiation depletes germ cell population. Therefore, the decrease in alkaline phosphatase activity is correlated with the state of germ cell population. ALP also plays an important role in maintaining membrane permeability. Radiation damages the cell membrane, might also be responsible for the decline in alkaline phosphatase activity [35].

LDH is associated with the maturation of germinal epithelial layer of seminiferous tubules and associated with post meiotic spermatogenic cells [36]. In the present study, a significant decrease in the activity of LDH was observed following irradiation treatment of rats compared to the control group (Table, 3). This result is similar to the found by Malhotra and Devi [37] who observed that exposure of rats to 3.0 Gy and 5.0 Gy resulted in reduced LDH concentration in the testicular tissue.

To counteract the harmful effect of reactive oxygen species (ROS), living organism is equipped with a protective network referred to as antioxidant defense, which includes antioxidative enzymes, non enzymatic antioxidant molecules, and enzymes reversing the cellular damage induced by oxidants [38]. SOD is a metalloprotein and accomplishes its antioxidant functions by enzymatically detoxifying the peroxides and superoxide anion [39]. GSH is one of the most important compounds, which helps in the detoxification and excretion of oxygen radicals. MDA is one of several low-molecular-weight end

products formed via the decomposition of certain primary and secondary lipid peroxidation products [39].

The present data revealed that exposure of rats to γ-radiation produced marked oxidative impact as evidenced by the significant increase in testicular lipid peroxidation as well as a significant decrease in testicular antioxidants including SOD, CAT activities and GSH content. This might reflect an inhibitory action of γ- irradiation on both enzymatic and non-enzymatic antioxidants in testis. In agreement with this result, Adaramoye *et al*., [40] revealed that exposure of rats to gamma-irradiation (5Gy) caused a significant increase ($p < .05$) in testicular lipid peroxidation (LPO) levels associated with a marked decrease in testicular catalase (CAT), superoxide dismutase (SOD) and reduced glutathione (GSH) levels. The decrease in GSH level may be due to its enhanced utilization as an attempt to detoxify the acute radiation-induced free radical damage as glutathione is a major endocellular nonenzymatic antioxidant and executes its radioprotective function through free radical scavenging mechanism [41].

Previous findings of Gehlot and Goyal [42] studies strongly suggest that radiation-induced depletion of glutathione resulted in an enhanced lipid peroxidation (LPO) as also observed in testicular tissue by Faidan *et al*. [43]. Since biomembranes of testicular tissues are rich in polyunsaturated fatty acid content and radiation-induced damage is mediated by ion of LPO, it is important to monitor oxidative damage to cellular membranes [44]. LPO produces a progressive loss of cellular integrity, fluidity of sperm membrane, and its motility, impairment in membrane transport function and disruption of cellular ion homeostasis in testes [45].

Many studies around the world proved that the selection of a particular food plant, plant tissue, or herb for its potential health benefits appears to mirror its polyphenol and flavonoid composition. Polyphenols act as antioxidants possibly through their O_2^- and singlet oxygen quenching ability as noticed by Hou *et al.* [46].

The present results indicate that the co-treatment of rats with *Ferula hermonis* (FH), bee honey (BH) or a mixture of both appears to produce a mitigating effect on γ-irradiation–induced testicular injury. It was found earlier that the plants of the Ferula genus include phytoestrogenic substances affect reproductive hormones such as progesterone, testosterone and oestrogens [47]. The active substances of phytoestrogen are isoflavones and ferutinin [48]. Non-toxic varieties of Ferula communis contain phytoestrogens with the active

compound ferutinin [49]. Ferutinin acts by stimulating the receptors in the hypothalamus; in particular, ferutinin binds with the oestradiol receptor of the pituitary gland in the male. This causes the hypothalamus to release the luteinising hormone (LH), subsequently causing the production and release of testosterone in the testis [50].

The data of the present work showed that oral supplementation of bees honey to rats induced a significant amelioration on the observed abnormalities due to exposure to γ-rays. This action was achieved by a marked improvement in the examined biochemical parameters including testicular functions. These observations may be attributed to the antioxidant properties of honey which contain the most important antioxidant trace elements iron, zinc and selenium which are thought to be essential cofactors for the enzymatic antioxidant defense system represented by catalase, superoxide dismutase and glutathione peroxidase [51]. Also, due to the antioxidant activity of its flavonoid compounds [12]. These compounds were known by their hydrogen donating antioxidant activities as well as their ability to form complexes with divalent transition metal cations [52]. Thus, this highly antioxidant capacity of bees honey made it able to scavenge the free radicals, reducing the level of lipid peroxidation [53]. The beneficial protective effects of bees honey have been described by Ezz El-Arab *et al,* [11]. They found that there was a direct link between the honey consumption and the level of polyphenolic antioxidants in the plasma. These findings further strengthen existing evidence that suggests that honey in the diet can provide people with protective antioxidant compounds.

In a previous study, Ozyurt *et al*., [54] studied the levels of testis oxidative stress parameters after establishing a dizocilpine induced psychosis model and showed the protective effects of caffeic acid phenethyl ester (CAPE), which is the active component of propolis from honey bee hives and has powerful antioxidant, anti-mitotic, antiviral and antiinflammatory properties [55]. Moreover, an investigation using lung tissues of Wistar albino rats revealed that the activity of antioxidant enzymes including catalase (CAT) and superoxide dismutase (SOD) were decreased in the radiation only group compared with the saline (control) and radiation group treated with the active component in propolies, indicating that CAPE treatment with radiation therapy attenuated radiation-induced pulmonary injury *in vivo*, possibly by its antioxidant effect [56]. Recently, Sirajudeen *et al*., [57] revealed that administration of honey significantly attenuated the toxic effects of cigarette smoke on spermatogenesis and testosterone level in rats.

Based on the above promising results, it can be concluded that FH or/and B H has the potential to mitigate the testicular injuries against the exposure of animals to a lethal dose of gamma radiation.

REFERENCES

1. Alonzo, F., Hertel-Aas, T., Gilek, M., Gilbin, R., Oughton, D.H. and Garnier-Laplace, J. (2008): Modelling the propagation of effects of chronic exposure to ionising radiation from individuals to populations. J. Environ. Radioact., 99: 1464-1473.

2. Doreswamy, K., Shrilatha, B., Rajeshkumar, T. and Muralidhara. (2004): Nickel-induced oxidative stress in testis of mice: evidence of DNA damage and genotoxic effects. J. Androl., 25(6): 996-1003.

3. Doreswamy, K. and Muralidhara. (2005): Genotoxic consequences associated with oxidative damage in testis of mice subjected to iron intoxication. Toxicology; 206: 169-178.

4. Hales, D. B., Allen, J. A. and Shankara, T. (2005): Mitochondrial function in Leydig cell steroidogenesis. Annals of the New York Academy of Sciences, 1061: 120–134.

5. Aitken, R. J. and De Iuliis, G. N. (2007): Origins and consequences of DNA damage in male germ cells. Reproductive BioMedicine Online, 14(6): 727–733.

6. Jedlinska-Krakowska, M., Bomba, G., Jakubowski, K., Rotkiewicz, T., Jana, B. and Penkowski, A. (2006): Impact of oxidative stress and supplementation with vitamins E and C on testes morpho-logy in rats. J. Reproduction and Development, 52(2): 203–209.

7. Ding, G.R. and Guo, G. Z. (2007): Advances in research of radio-protectant. J. Radiat. Res. Radiat. Process, 25: 321-324.

8. Ogbera, A.O., Dada, O., Adeyeye, F. and Jewo, P.I. (2010): Complementary and alternative medicine use in diabetes mellitus. West Afr. J. Med., 29(3): 158-162.

9. Khleifat,K., Homady, M.H., Tarawneh,K.A. and Shakhanbeh, J.(2001): Effect of Ferula hormonis Extract on Social Fertility and Some Physiological Parameters Male Mice Aggression, in Prepubertal. Endocrine J., 48 (4), 473-482.

10. Codex A limentarius Commission, author. Codex Standards for sugar (honey). (1989): Supplement 2 to codex Alimentarius, Volume 111.

Rome: Food and Agriculture Organisation of the United Nations and World Health Organization.

11. Ezz El-Arab, A.M., Girgis, S.M., Hegazy, E.M. and Abd El-Khalek, A.B. (2006): Effect of dietary honey on intestinal microflora and toxicity of mycotoxins in mice. BMC. Complementary and Alternative Medicine, 6: 6.
12. Merken, H.M. and Beecher, G.R. (2000): Measurement of food flavonoids by high performance liquid chromatography: a review. J. Agri. Food Chem., 48(3): 577-599.
13. Jones, H. R. (2001): Honey and healing through the ages. In Honey and Healing, edited by P. A. Munn and H. R. Jones. Cardiff, UK: BRA
14. Gheldof, N., Wang, X. H.and Engeseth, N. J. (2002): Identification and quantification of antioxidant components of honeys from various floral sources. J. Agric. Food Chem., 50:5870-5877.
15. Baltrus˘aityt, V., Venskutonis, P.R. and C˘ eksteryt, V. (2007): Radical scavenging activity of different floral origin honey and beebread phenolic extracts. Food Chem., 101:502–514.
16. Gheldof, N., Wang, X. H. and Engeseth, N.J. (2003): Buckwheat honey increases serum antioxidant capacity in humans. J. Agric. Food Chem., 51:1500-1505.
17. Hegazi, A.G. and Abd El-Hady, F.K. (2009): Influence of honey on the suppression of human low density lipoprotein (LDL) peroxi-dation (*In vitro*). Evid Based Complement Alternat. Med., 6:113-121.
18. Babson, L.A. (1965): Phenolphalein monophosphate methods for the determination of alkaline phosphatase. Clin. Chem., 11: 789.
19. Babson, A.L. and Ready, A.P. (1959): Colourimetric method for the determination of total and prostatic acid phosphatase. Am. J. Clin. Path., 32: 89-91.
20. Moss, D. W. and Handerson, A.R. (1994): Lactate dehydrogenase 2nd Ed., Textbook of clinical chemistry, chapter 20, Enzymes, pp.812-818.
21. Sanchez-Carbayo, M et al. (1998): Elecsys Testosterone Assay Evaluated. Clin. Chem., 44(8 Pt 1):1744-6.
22. Ohkawa, H., Ohishi, N. and Yagi, K.(1979): Assay for lipid peroxidation in animal tissues by thiobarbituric acid reaction. Anal Biochem., 95:351–8.

23. Nishikimi, M., Rao, N. A. and Yagi, K. (1972): The occurrence of superoxide anion in the reaction of reduced phenazine methosulfate and molecular oxygen. Biochem. Biophys. Res. Commun., 46(2): 849–54.

24. Aebi, H. (1984): Catalase *in vitro*. *In*: Methods in Enzymology, Academic Press, New York, pp.479-500.

25. Jagetia, G. C., Jyothi, P. and Krishnamurthy, H. (1998): Effect of vindesine sulfate on the radiation-induced alterations in mouse spermatogenesis: a flow cytometric evaluation," Mutation Research, 398(1-2): 163–174.

26. Kackar, R., Srivastava, M.K. and Raizada, R.B. (1997): Induction of gonadal toxicity to male rats after chronic exposure to mancozeb. Ind. Health, 35: 104-111.

27. Jegou, B., Velez Delacalle, J.P.and Bauche, F. (1991): Protective effect of hydroxy –progesterone acetate plus testosterone against radia-tion induced damage to the reproductive function of male rats and their offspring. Proc-Natl Acad. Sci., 57:8710.

28. Dygalo, N., Sakhrov, D.G. and Shishkina, G. T. (1997): Cortico-sterone and testosterone in the blood of adult rats: The effects of low doses and the times of the action of ionizing radiation during intra uterine development. Rad. Biol. Radioecol., 37(3):377.

29. Said, U. Z., Azab, Kh.Sh. and Soliman, S.M. (2005): Cress oil modulates radiation-induced hormonal, histological, genetic disorders and sperm head abnormalities in albino rat.

30. Johnson, A.D., Gomes, M. and Vandemark, N.L. (1970): The testis. 1st Ed., Academic Press, New York and London.

31. Szeinfeld, D. and De Villiers, N.(1992): Radioprotective proper-ties of ATP and modification of acid phosphatases response after a lethal dose of whole body P (66 MeV)/Be neutron radiation to BALB/ c mice. Cancer Biochem. Biophysics ,13:123–32.

32. Chemes, H. (1986): The phagocytic function of Sertoli cells: a morphological, biochemical and endocrinological study of lysosomes and acid phosphatase localization in the rat testis. Endocrinology, 119:1673–81.

33. Samarth, R. M., Goyal, P. K. and Kumar, A. (2001): Modulatory effect of *Mentha piperita* (Linn.) on serum phosphatases activity in Swiss albino mice against gamma irradiation. Indian J. Exp. Biol., 39**:**479–82.

34. Kornblatt, M. J., Klugerman, A. and Nagy, F. (1983): Character-ization and localization of alkaline phosphatase activity in rat testes. Biol. Reprod., 29:157–64.

35. Highman, B. and Hanks, A.R. (1970): Serum intestinal alkaline phosphatase in rats after 800R whole body or regional X-irradiation. Proc. Soc. Exp. Biol. Med., 133; 1201–6.

36. Sinha, N.,Narayan, R. and Saxena, D.K. (1997): Effect of endo-sulfan on the testes of growing rats. Bull. Environ. Contam. Toxicol., 58 : 7986.

37. Malhotra, N. and Devi, P. (2005): Radio protective Influence of Vitamin E on Energy Generating Enzymes in Prepubertal and Mature Rat Testis. Ind. J. Gerontology, 19(1):1-10.

38. Sharma,M. and Kumar, M. (2007): Radioprotection of Swiss albino mice by Myristica fragrans houtt. J. Radiat.Res.,48:135-141.

39. Yang, J., Wu, G., Feng, Y., Lv, Q,. Lin, S. and Hu, J. (2010): Effects of taurine on male reproduction in rats of different ages. J. Biomedical Science, 17(Suppl 1):S9 .

40. Adaramoye, O.A., Adedara, I.A., Popoola, B.and Farombi, E. O. (2010): Extract of Xylopia aethiopica (Annonaceae) protects against gamma-radiation induced testicular damage in Wistar rats. J. Basic Clin. Physiol. Pharmacol. 21(4):295-313.

41. Bump, E. A. and Brown, J. M. (1990): Role of glutathione in the radiation response of mammalian cells in vitro and in vivo. Pharm. and Therapeutics, 47(1) 117–136.

42. Gehlot, P. and Goyal, P. K.(2007): Rectification of radiation-induced damage in swiss albino mice by aloe vera leaf extracts (AVE)," Iran.J. Rad. Res., 5|(2): 71–78.

43. Fatih Fidan, A., Enginar, H., Cigerci, H., Korcan, E. and Ozdemir, A. (2008)" The radioprotective potential of Spinacia oleraceae and Aesculuc hippocastanum against ionizing radiation with their anti-oxidative and antioxidative properties. J. .Animal and Veterinary Advances, 7(12):1528–1536.

44. Alvarez, J. G. and Storey, B. T. (1995): Differential incorporation of fatty acids into and peroxidative loss of fatty acids from phospho-lipids of human spermatozoa. Molecular Reproduction and Develop-ment, 42(3): 334–346.

45. Aitken, R. J. and Baker, M. A. (2004): Oxidative stress and male reproductive biology.Reproduction, Fertility and Development, 16(5): 581–588.

46. Hou Z., Lambert, J. D., Chin, K. V. and Yang, C. S.(2004): Effects of tea polyphenols on signal transduction pathways related to cancer chemoprevention. Mutation Research, 555(1-2): 3–19.

47. Aragno, M., Tagliapietra,S., Nano, G.M. and Ugazia, G.(1988): Experimental studies on the toxicity of Ferula communis in the rat. Res. Commun. Chem. Pathol. Pharmacol., 59:399-402.

48. Appendino, G., cravotto, G., Sterner, O. and Ballero, M. (2001): Oxygenated sesquiterpenoids from a non-poisonous sardinian chemo-type of giant fennel (Ferula communis). J. Nat. Prod. 64: 393-395.

49. Sacchetti, G., Appendino, G., Ballero, M., Loy, C. and Poli, F. (2003): Vittae fluorescence as a tool to differentiate between poisonous and non-poisonous populations of giant fennel (Ferula communis) of the island of Sardinia (Italy). Biochem. Systematics and Ecology, 31(5):527-534.

50. Anonymous, (2004): www.gcwhite.co.uk/Ferula.htm (04/ 05/2004).

51. Machlin, I. K. and Bendich, A. (1987): Free radical tissue damage: protective role of antioxidant nutrients. Free Radic. Biol. Med., 6:441-445.

52. Soler, C., Gil, M.I., Garcia-Viguera, C. and ThomasBarberan, F. (1995): Flavonoid patterns of French honeys with different floral origin. Apidologie, 26: 5360.

53. El-Khayat, Z., Ahmed, R. E. , Mahmoud, S. A., Wafaa, I., R. and Tahany, R. E.(2009): Potential Effects of Bee Honey and Propolis Against the Toxicity of Ochratoxin A in Rats. Maced J. Med. Sci., 15; 2(4):311-318.

54. Ozyurt, B., Parlaktas, B.S., Ozyurt, H., Aslan, H., Ekici, F. and Atis, O. (2007): A preliminary study of the levels of testis oxidative stress parameters after MK-801-induced experimental psychosis model: protective effects of CAPE. Toxicology; 230.

55. Hui-Ping, L., Ching-Yu, L., Chiech, H., Liang-Cheng, S. and Chih-Pin, C. (2012): Anticancer Effect of Caffeic Acid Phenethyl Ester**.** Pharmacologia, 3(1):26-30

56. Yildiz, O. G., Soyuer, S., Saraymen, R. and Eroglu, C. (2008):

Protective effects of caffeic acid phenethyl ester on radiation induced lung injury in rats. Clin. Invest. Med., 31:E242-7.

57. Sirajudeen, N. S., Ismail, Z. I. and Islam, M. N.(2011): Effect of honey on testicular functions in rats exposed to cigarette smoke. J. ApiProduct & ApiMed-ical Sci**.,** 3 (1): 12 – 17.

مجلة البحوث الإشعاعية
والعلوم التطبيقية

مجلد ٤ عدد ٤ (أ) ص ص 1201 – 1217 (٢٠١١)

التأثيرات المضاد للأكسدة لشرش الزلوع وعسل النحل ضد الأجهاد التأكسدى الناشىء عن أشعة جاما فى خصية الجرذان

نادية نور عثمان

قسم بحوث تشعيع الأغذية – المركز القومى لبحوث وتكنولوجيا الإشعاع، هيئة الطاقة الذرية، ص ب٠ ٢٩ مدينة نصر، القاهرة، مصر.

الإشعاعات المؤينة هي واحدة من العوامل البيئية التي قد تسهم في ضعف الإنجاب من خلال آلية تنطوي على الاجهاد التأكسدى. أجريت هذه التجربة لدراسة التأثير الواقى المحتمل لشرش الزلوع و/أو عسل النحل فى تحسين الأضرار التى يحدثها الإشعاع فى الخصية. قسمت الدراسة الى خمس مجموعات (٦ فئران لكل منهم) المجموعة ١ الضابطة والمجموعة ٢ تم تعريضها لجرعة إشعاعية ٨ جراى والمجموعات ٣-٥ تم إمدادها بكل من شرش الزلوع (٣ملجرام/كجم) و عسل النحل (١,٥ ملى/ كجم) وكلاهما معا على التوالى لمدة عشرة ايام متتالية قبل التعرض للإشعاع وعشرون يوم بعدة.

أوضحت نتائج هذه الدراسة أن التعرض لأشعة جاما أدى الى انخفاض معنوي فى وزن الخصية و مستوى بعض الهرمونات الجنسية مثل التستوستيرون وFSH و LH فى مصل الدم . لوحظ انخفاض معنوى فى نشاط إنزيمات الخصية مثل الفوسفات القلوى (ALP) وانزيم اللكتات ديهيدروجيناز (LDH) بينما حدثت زيادة كبيرة في نشاط انزيم الفوسفاتيز الحمضي (ACP). كذلك ادى التعرض للاشعاع الى حدوث نقص معنوى فى نشاط السوبر أوكسيد ديسميوتيز(SOD) ونشاط الكتاليز(CAT), مستوى الجلوتاثيون (GSH) مصحوبا بزيادة معنوية فى مستوى ناتج الأكسدة الفوقية (المالونداهيد) فى نسيج الخصية. تشير النتائج إلى أن شرش الزلوع و/او عسل النحل يملك إمكانات كبيرة وقائية ضد العجز الناجم عن الإشعاع لوظائف الخصية. وذلك بتعديل الانخفاض فى وزن الخصية وتحسن فى الإنزيمات المضادة للأكسدة وإنزيمات الخصية والهرمونات الذكرية. من هذه النتائج تخلص هذه الدراسة الى أهمية استخدام شرش الزلوع و/او عسل النحل للحماية من السمية التناسلية الناتجة عن التعرض للإشعاع وذلك عن طريق زيادة آليات الدفاع المضادة للأكسدة.