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- أحكام غزوة خيبر الفقهية .

الافتتاحية

من السمات الطيبة الحميدة التي يتميز بها مجتمعنا العربي عامة والليبي خاصة سمة التسامح والتكافل والتعاضد، متأثرين بأخلاق أجدادنا، متبعين لتعاليمَ حثنا عليها ديننا قال تعالى﴿وتعاونوا على البر والتقوى﴾ ولكن المجتمعات قد تعتريها الغفلة فيصيبها شيء من الخلل فتنقلب القيم والمفاهيم لديهم، تحل البغضاء محل الحب، والانتقام محل التسامح، فما أحوجنا اليوم أكثر من أي وقت مضى إلى التشبث بهذه الأخلاق النابعة من ديننا الإسلامي.

لقد تفشت وبشكل ملفت للنظر الكراهية والحقد بين أبناء المجتمع، وسرت في دمائهم النفعية الضيقة، والأنانية المقيتة، إن هذه الأخلاق السيئة ليست من سمات مجتمعنا، ولا من تعاليم ديننا، وإنها لمن عوامل الضعف قال تعالى:﴿ ولا تنازعوا فتفشلوا وتذهب ريحكم﴾ فالحب والوئام روح القوة والسمو، وهو جوهر الأخلاق والدين، والإنسان المتوازن نفسيا والمتشبع بتعاليم الدين كله تسامح وإحسان، فإن الإناء بما فيه ينضح، يحسن الظن بالآخرين، ويلتمس العذر للمخطئين .

وما الصراعات في المجتمعات الإسلامية عامة والليبي خاصة إلا نتاج هذه الكراهية المصنوعة، والبغض المبثوث، والتنافس غير الشريف، مما يجعلنا فريسة سهلة المنال للأعداء، انتشرت الكراهية حتى أصبحت الكلمات النابية والجارحة تتقاذف بين الناس، والأدهى والأمرّ أن تنتشر بين بعض طلبة أهل العلم، وعلى منابر العلم والمعرفة، وأصبح دم المسلم يراق صباحا ومساء، ليلا ونهارا، بذنب وبدون ذنب.

لقد تقدمت قضايا هامشية على حساب أخرى جوهرية مصيرية، فأين قضية فلسطين والقدس وما يفعله بأهلها اليهود أعداء الله مما يدور الآن، فعلى أهل العلم الفضل وبخاصة أساتذة الجامعات والباحثين أن يتقدموا الصفوف في الدعوة لنبذ الكراهية وإنعاش بذرة الخير في قلوب الناس، وتعزيز دعائم الحب والوئام . هيئة التحرير

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Abstract

The Swedish National Authority reported the presence of elevated levels of acrylamide (ACR) in certain types of food processed at high temperature. The present study was performed to evaluate the toxicity of ACR in different tissues ofthe weaning male and female rats after 14 and 28 days as well as two weeks of ACR stopping effect. ACR induced inhibition in the activities of the liver aminotransferases (ALT and AST)and alkaline phosphatase (ALP). Brain acetylcholinesterase (AChE) activity was significantly decreased in the male treated rats only. Stopping of ACR could not resume the activities of the studied enzymes. ACR induced a general decrease effect in glutathione reduced (GSH) level in the different studied tissues of male and female rats. Malondialdehyde (MDA) level significantly increased in liver and brain of both male and female rats following administration of ACR for 14 and 28 days.Acrylamide also showed significant inhibition in the catalase (CAT)activityin the all studied tissues following 14 and 28 days. The present study recommends restriction of ACR exposure either occupationally or in food containing product especially for children.**Estimation of enzymatic activities in liver:** Liver aspartate aminotransferase

(AST; EC 2. 6. 1. 1) And alanine aminotransferase (ALT; EC 2. 6. 1. 2) activities were assayed by the method of Reitman and Frankel [32], while liver alkaline phosphatase (ALP ; EC 3. 1. 3. 1) activity was assayed using the method of Belfield and Goldberg [33]. Brain acetylcholinesterase (AChE; EC 3. 1. 1. 7) activity was estimated using acetythiocholine iodide as a substrate [34].

Estimation of oxidative stress markers: Lipid peroxidation in the supernatants of different tissue organs was measured by the formation of malondialdehyde (MDA) method [36]. The level of total acid-soluble SH compound (glutathione GSH) in the different tissues was determined according to Aykac et al. [37]. Superoxide dismutase (SOD) was determined according toNishikimi[38].

Key words: Acrylamide - Weaning rats- Aminotransferases – MDA – GSH – AChE.

Introduction

Acrylamide (ACR) is a highly reactive vinyl, water soluble monomer with a molecular formula of C_3H_5NO [1]. The Swedish National Authority reported the presence of elevated levels of ACR in certain types of food processed at high temperature [2].Acrylamideusually formed through the Maillard reaction during the heating process of foods containing carbohydrates and proteins by interactions of amino acids, especially asparagine, with reducing sugars like glucose [3].In industry, ACR is produced to be used as a chemical intermediate in the production and synthesis of polyacrylamides, which are used as flocculants for wastewater treatment, in adhesives and grouts, soil stabilizers and in laboratory gels [4,5]. In scientific research ACR is also used to selectively modify-SH groups and as a quencher of tryptophan fluorescence in studies designed to elucidate the structure and functions of proteins [6]. Recent findings of the presence of ACR in starch foods

cooked at high temperature have refocused worldwide attention on its carcinogenicity [7,8,9,10].

The generalpublic may be exposed to ACR through the ingestion of drinking water that is contaminated with acrylamide from foods [11, 12]. It has been also reported that ACR was formed during the heating of rodent feed, suggesting that human exposure to ACR could occur during the cooking of rodent food [13]. Furthermore, tobacco smoke is an important source of human exposure to ACR [1]. Although the polymeric form of ACR is reported to be nontoxic, its monomeric form has a potential to cause a wide spectrum of toxic effects [14, 15, 16]. It is reported to be a multisite carcinogen, which can induce tumors of the adrenal, thyroid, CNS, oral cavity, testis, mammary glands and uterus [17, 18, 10]. Food and Drug Administration issued preliminary exposure estimates of food-derived ACR, which are 0.43 and 1.06 mg/kg per day for adults and children, respectively [19].

The principal toxic effect of ACR monomer isneurotoxicity[15, 20, 21].Neurotoxicological effects of ACR, includingparesthesias in the fingers, coldness and weakness of the hands, numbness in the lower limbs, drowsiness, hallucinations, ataxia, convulsion, diffused damage to different sections of the nervous system, lysis in the cerebellar neuronsand tibial nerve degeneration [22, 23]. In addition to neurotoxicity, reproductive toxicity of ACR has been also studied in different experimental models including toads [24], mice [15] and rats [25, 26].

Oxidative stress has been demonstrated to be one of the key mechanisms in many chemicals – induced cell injuries. Oxidative stress in the cells or tissues refers to the enhanced generation of reactive oxygen species (ROS) and / or depletion of antioxidant defense system, causing an imbalance between peroxidants and antioxidant, potentially leading to damage [27, 28, 29, 30]. [21] reported that ACR generates reactive oxygen species which may

cause disturbances in the oxidative status and enzyme activities in rats. Furthermore,[27] showed that ACR induced neurotoxicity, which may be associated with enhancement of lipid peroxidation and reduction of the oxidative capacity.

Acrylamide toxicity in the weaning rats has been previously studied [31].But the disturbances in the oxidative status and enzyme activities in the weaning rats still need more investigation. So, the present study was performed to evaluate the toxicity of ACR in the different tissues of male and female weaning rats and to elucidate the role of the oxidative stress in ACR – induced toxicity as well as to study the withdrawal effect of acrylamide for two weeks.

Materials and Methods

Chemical:

Acrylamide monomer dry crystals (C3H5NO, > 99% purity), CAT No. 150256 79-061 purchased from MP Biomedicals, LLC. France was used in the present study..

Animals:

The experimental animals used in this study were the weaning male and female Wister rats (*Rattusnorvegicus*) weighing 50-60 $\pm$ 5 g.

The animals were obtained from the National Research Center (NRC, Dokki, Giza).Animals were grouped and housed in polyacrylic cages (six animals per cage) in the well– ventilated animal house of the Department of Zoology, Faculty of Science, Cairo University. Animals weregiven food and water ad libitum. Rats were maintained in a friendly environment with a 12 h/12 h light-dark cycle at room temperature (22^0C – 25^0C). Rats were acclimatized to laboratory conditions for 7 days before commencement of the experiment.

Experimental design:

After acclimation, weaning male and female rats (n = 60 for each) were divided into 2 groups (n = 30 for each) (Fig. 1). Animals of the 1st group served to study the acrylamide (ACR) administration effects and subdivided into 2 subgroups. The animals of the 1st subgroup (n = 20) were administered a daily dose of acrylamide (15 mg / Kg. b. wt. dissolved in dist. Water) for 14 and 28 days. Animals of the 2nd subgroup (n = 10) served to study the effect of the ACR withdrawal, the animals were given ACR for 28 days, then the ACR administration was stopped for 2 weeks. The animals of the second group (n = 30) served as the time–matched control for the 2 previous subgroups, the animals were administered equivalent volumes of dist. Water. The same protocol was designed for female rats (n = 60). Protocol was approved by the Cairo university, faculty of Science Animal Care and Use Committee (IACUC) (Egypt), and all the experimental procedures were carried out in accordance with international guidelines for care and use of laboratory animals.

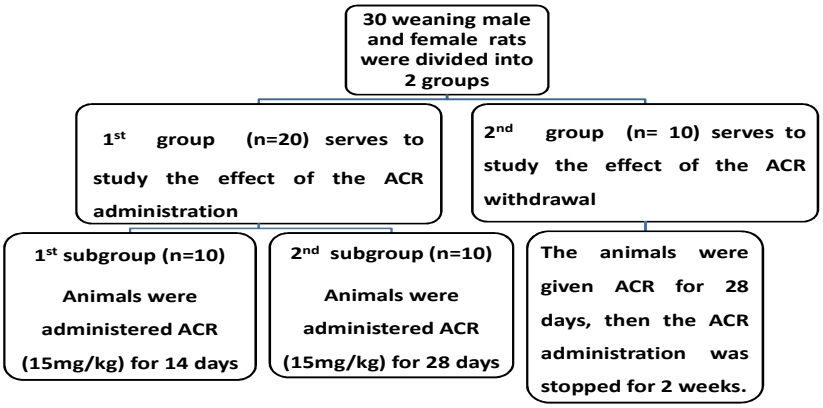

Fig. (1):Experimental design of acrylamide administration and withdrawal.

Handling and tissue sampling:

At the end of each experimental period the rats (control & experimental) were killed by cervical dislocation and the liver, brain, kidney, testes and ovary were removed immediately and washed with saline solution and stored at –80^{o}C for oxidative stressand biochemical studies.

Tissue preparation for oxidative stress and biochemical Studies:

The collected tissues were minced and homogenized (10% w/v) separately in ice-cold 0.1 M phosphate buffer (pH 7.4). The homogenate was centrifuged at 3000 x g for 15 min at 4^{o}C and the resultant supernatant was used for different analytical assays.

Experimental procedures:

Estimation of enzymatic activities in liver:

Liver aspartate aminotransferase (AST; EC 2. 6. 1. 1) And alanine aminotransferase (ALT; EC 2. 6. 1. 2) activities were assayed by the method of Reitman and Frankel [32], while liver alkaline phosphatase (ALP ; EC 3. 1. 3. 1) activity was assayed using the method of Belfield and Goldberg [33]. Brain acetylcholinesterase (AChE; EC 3. 1. 1. 7) activity was estimated using acetythiocholine iodide as a substrate [34].

Estimation of protein concentration:

Protein concentration in the supernatants of liver, kidney, testes, ovary and brain was assayed by the method of Lowry et al. [35] using bovine serum albumin as a standard.

Estimation of oxidative stress markers:

Lipid peroxidation in the supernatants of different tissue organs was measured by the formation of malondialdehyde (MDA) method [36]. The level of total acid-soluble SH compound (glutathione GSH) in the different tissues was determined according to Aykac et al. [37]. Superoxide dismutase (SOD) was determined according to Nishikimi[38].

Statistical analysis:

Results are presented as means $\pm$ SE. For comparisons between each experimental group and the corresponding control group. Percentage difference representing the percent of variation with respect to the control group was also calculated. To evaluate differences between the groups studied, one way analysis of variance (ANOVA) with the LSD post hoc test was used to compare the group means and $P<0.05$ was considered statistically significant. SPSS, for Windows (Version 15.0) was used for statistical analysis.

Results

The effect of acrylamide (ACR) (15 mg/kg. body weight) on liver ALT, AST and ALP activities are presented in table (1). The tested dose level of ACR induced significant decrease ($P < 0.05$) in the ALT, AST and ALP activities following 14 days in the liver of intoxicated male and female weaning rats as compared to their time matched controls. The recorded results following 28 days of ACR administration showed significant decrease ($P < 0.05$) in the activities of the studied enzymes in the male weaning rats only as compared to their corresponding control. While female weaning rats showed a significant decrease ($P < 0.05$) in the activity of the ALP only following ACR intoxication. Stopping ACR administration for 2 weeks significantly decreased ($P < 0.05$) AST and ALP activities in the liver of male weaning rats when compared to their time matched control (Table 1). On the other

hand, as regards to the female rats, ACR stopping decreased significantly ($P < 0.05$) ALP activity as compared to the corresponding control (Table 1).

The data recorded in Table (2) showed the levels of AChE activity in the control and ACR intoxication in weaning male and female rats. The activity of AChE was significantly ($P < 0.05$) decreased in the brain of male weaning rats after 14 and 28 days of ACR intoxication as well as in the withdrawal periods. On the other hand AChE activity non significantly changed ($P > 0.05$) in the brain of the female weaning rats.

Figures (2-5) show the effect of ACR on glutathione content (GSH) in the different tissue organs of weaning male and female intoxicated rats. The recorded results proved that the GSH level exhibited a general decrease following ACR intoxication in the studied tissue organs of both sexes. GSH level was decreased significantly ($P < 0.05$) in the liver and kidney tissues of the treated weaning male following 14 days of the ACR exposure, while weaning female rats showed significant decrease in the GSH level in the kidney tissues only after 14 days of the ACR administration (Figs. 2 and 3). Acrylamide exposure for 28 days caused significant decrease($P < 0.05$) in the GSH levels in the liver, kidney and reproductive organs (testis and ovary) of the treated weaning male and female rats as compared to the corresponding control (Figs. 2, 3 and 5). The recorded results also showed that GSH levels in the brain tissues were significantly ($P < 0.05$) decreased in the treated weaning male only (Fig. 4). As illustrated in Figs. (2-5), stopping of the acrylamide for two weeks does not affect GSH levels in the all studied tissue organs of both sexes except in the liver of the treated weaning female rats (Fig. 2).

The data recorded in Figs. (6-9) indicated that ACR induced increase in the levels of malondialdehyde (MDA) in the different tissue organs of both studied sexes following all experimental

periods. However, this increase was significant ($P < 0.05$) in the liver and brain of ACR intoxicated weaning male and female rats following 14 days (Figs. 6 and 8). Oral administration of ACR for 28 days showed significant increase ($P < 0.05$) in the MDA levels in the all studied tissue organs of both sexes (Figs. 6-9). Studying the effect of ACR stopping for 2 weeks on both male and female intoxicated rats, Figs. (6 and 8) showed that MDA still significantly increased ($P < 0.05$) in the liver and brain of the male intoxicated rats, while in the female intoxicated rats, significant increase ($P < 0.05$) in MDA levels were noticed in the kidney and ovary tissues (Figs. 7 and 9) as compared to their time matched control.

Concerning the effect of the ACR intoxication on the CAT activity in the different tissues of the intoxicated male and female (Figs. 10-13), the obtained results showed that ACR induced significant inhibition($P <0.05$) in the CAT activities in all studied tissues following 14 and 28 days of the exposure. However, this inhibition was also significant following 2 weeks of ACR stopping except in the testis of the treated male rats (Fig. 13) and kidney of the treated female rats (Fig. 11)

Discussion

The toxicity of acrylamide (ACR) on human and experimental animals was well documented in a series of reports since the Swedish Food Administration alarm in 2002 [39, 40]. Acrylamide is a small organic molecule with very high water solubility. These properties facilitate its rapid absorption and distribution through the body[41]. Alteration in the biochemical parameters isa sensitive index to changes to xenobiotics and can constitute an important diagnostic tool in the toxicological studies. Aminotransferases are the first enzymes to be used in diagnostic enzymology when liver damage has occurred [42].Because of their intracellular location in the cytosole, toxicity affecting the liver

with subsequent breakdown in the membrane architecture of the cells leads to their spillage into plasma and their concentration rises in the latter. In conjunction with the report of Yousef&El-Demedash [29],Shuming et al. [43] and Rawi et al. [44], data from the present investigation reflects that, ACR intake inhibited the activities of the aminotransferases (AST and ALT) in the liver tissues of the male and female rats after 14 and 28 days. Phosphatases are important and critical enzymes in biological processes, they are responsible for detoxification, metabolism and biosynthesis of energetic macromolecules for different essential functions. Any interference in these enzymes leads to biochemical impairment and lesions of the tissue and cellular function [45]. In the present study, the inhibition of ALP activities in the liver tissues of the male and femaleweaning rats followingacrylamide administration for 14 and 28 days, may be a consequence of the changes in the permeability of the plasma membrane in addition to changes in the balance between synthesis and degradation of enzyme protein thus lowering the enzyme activity [46].

Previously finding has shown that ACR has an affinity to bind with DNA and can cause chromosomal aberrations [47]. Thus any abnormality in DNA structure can affect transcription and ultimately protein synthesis, which can explain the inhibition of the liver enzyme activities following ACR intoxication. Moreover, as reported by Friedman [6], the ACR molecule has two reactive sites, the conjugated double bond and the amide group. Therefore, it can conjugate with the –SH group of a sulfur amino acids, the α –NH_2 group of a free amino acid, the ε – NH_2 group of lysine, the ring NH group of histidine and the N- terminal residue of a protein which can explain the unavailability of a few amino acids for proteinsynthesis, which might consequently be a reason for the depleted protein content and enzyme activities in the liver tissue.

Acrylamide is a well-known neurotoxic compound produces central and peripheral axonopathy [20, 48]. The deleterious effects of ACR or its metabolite glycidamide seemed to become from their high electrophilic property as a result of presence of alpha and beta unsaturated system on its structures which facilitate them to form adducts with sulphydryl groups on hemoglobin and other proteins [49, 50]. This may reduce the hemoglobin surface of carrying oxygen to the tissues causing cell degeneration. The present study indicated that treatment with ACR caused inhibition in the activity of the AChE in the brain tissues of intoxicated male and female rats. In agreement with our results, Yousef& El-Demerdask [29] found that AChE inhibition in brain and plasma following ACR intake in male rats. LoPchin and Canady [40]suggested that the ACR - induced synaptic dysfunction, which involved in the adduction of presynaptic protein thiol groups and subsequent reduction in neurotransmitter release. Moreover, Barber and LoPchin [51]reported that the neurological defects associated with ACR intoxication are mediated by impaired neurotransmission at central and peripheral synapses.

Free radicals and reactive oxygen species (ROS) in biology gains more attention, and there is increasing awareness of the ubiquitous role of oxidative stress in neuropathy [52, 53]. In order to elucidate the correlation between oxidative stress and ACR induced toxicity, the time - dependent changes of the oxidative molecules malondialdehycle(MDA),glutathione (GSH) levels and catalase activity were examined.

Oxidative stress is usually caused by the increase of intracellular peroxidant species such as hydrogen peroxide, hydroxyl radicals and superoxide anion radicals. Endogenous GSH can react directly with ROS, protects thiol groups in proteins from oxidation. ROS can attack the polyunsaturated fatty acids in the biomembrane to initiate free radical chain reaction, resulting in the

enhancement of lipid peroxidation. MDA usually has been used as biomarkers of lipid peroxidation for many years [54, 55].

Metabolism of ACR in the body may result in the generation of ROS, which play a role in the oxidative stress of ACR and cause oxidative DNA damage which play a role in its carcinogenicity [56]. Naruszewicz et al. [57] reported that chronic intake of acrylamide – containing potato chips increases the production of the reactive oxygen radicals by leukocytes and increases plasma C- reactive protein. Glutathione (GSH), a tripeptide present in the liver, kidney, brain and erythrocytes has a significant binding capacity with toxic substances resulting in the formation of usually non-reactive conjugates[58]. The present study confirmed the finding of Yousef and El-Demerdash [29], El-Sayed et al. [30] and Zhu et al. [27] who reported that, ACR exposure markedly decreased GSH contents in following ACR intoxication. Previous studies showed that conjugation with GSH is a mechanism for the detoxification of ACR [59]. ACR-GSHconjugation was the major metabolic rout in rats accounting for 65 % [60]. Depletion of GSH is associated with an increase in ACR genotoxicity but seems also to lead to a substantial enhancement of cytotoxicity [61].

Lipid peroxidation is known to decompose and produce a variety of substances, the most important of which is MDA [62]. In the current study, the induction in the levels of MDA in the different studied tissues in the ACR intoxicated weaning male and female rats is in agreement with the finding ofYousef and El-Demerdash, [29], El-Sayed et al. [30] and Zhu et al. [27]. Their data strongly indicated that the elevation of MDA and the depletion of the GSH levels were involved in the development of ACR-induced toxicity. The present study also showed that greatest induction in the MDA level was recorded in the reproductive tissues. In agreement with the our finding, El-Sayed et al. [30]

reported that, the highest increase in the MDA level was detected in the testis tissue of ACR intoxicated male rats.

Catalase (CAT) is a key component of the antioxidant defense system. Inhibition of such system results in enhanced sensitivity to free radical-induced cellular damage [63]. Viewed in conjunction with the report of Catalgolet al. [64], the inhibition of CAT activity following ACR intoxication in the present study may be due to the enhancement of the peroxidation end product MDA, which is known to inhibit protein synthesis and the activities of certain enzymes. Escobar et al. [65]indicated that enhanced, free radical concentrations resulting from oxidative stress conditions can cause loss of enzymatic activities.

In conclusion, on the basis of obtaining results ACR toxicity in the weaning rats may be mediated in one hand by disturbances in the enzyme activities as indicated by the inhibition in their activities and on the other hand by oxidative stress as indicated by a decrease in GSH and induction in the MDA levels as well as inhibition of the CAT activity in the different studied tissues. The results also indicated that the withdrawal of ACR requires longer time than 2 weeks.The present study recommends restriction of acrylamide exposure either occupationally or in food containing product in addition, especially for children, raising awareness of people about its hazards.

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Conflict of Interests:

There is no any financial relation with the commercial identities mentioned in the manuscript.

References

1. Grivas S, Jagerstad M, Lingnert H, Stog K, Tornqvist M , Aman P. (2002). Acrylamide in food: mechanisms of formation and influencing factors during heating of foods. Food &Nutrition Research. 46(4):159-172.
2. SNFA (2002). Swedish National Food Administration. Acrylamide in food. Swedish National Food Administration, Uppsala.
3. Mottram, D S, Wedzicha, B L Dodson, A T (2002). Acrylamide is formed in the Maillard reaction. Nature, 419: 448-449.
4. Dybing E, Sanner T. (2003).Risk assessment of acrylamide in foods. Toxicol.Sci. 75(1):7-15.
5. Chang Q, Hao X, Duan L. (2008). Synthesis of crosslinked starch-graft- Polyacrylamide –co – sodium xanthate and its performances in wastewater treatment.J Hazard Mater.159(2-3): 548-453.
6. Friedman M. (2003). Chemistry, biochemistry, and safety of acrylamide. A review.JAgric Food Chem. 51(16):4504-4526.
7. Hogervorst J, Schouten L, van den Brandt P. (2009). Reaction on Gargas et al.: Acrylamide: consideration of species differences and nonlinear processes in estimating risk and safety for human ingestion.FoodChemToxicol. 47(11):2871-2872.
8. Zhang X. (2009). Simultaneous exposure to dietary acrylamide and corn oil developed carcinogenesis through cell proliferation and inhibition of apoptosis by regulating p53-mediated mitochondria-dependent signaling pathway.ToxicolInd Health, 25(2):101-109.
9. Zhang X, Cao J, Jiang L, Geng C, Zhong L. (2009). Protective effect of hydroxytyrosol against acrylamide-induced

cytotoxicity and DNA damage in HepG2 cells.Mutat Res. 664(1-2):64-68.

10. Beland FA, Mellick PW, Olson GR, Mendoza MC, Marques MM, Doerge DR. (2013). Carcinogenicity of acrylamide in B6C3F(1) mice and F344/N rats from a 2-year drinking water exposure. Food ChemToxicol. 51:149-159.
11. Lucentini L, Ferretti E, Veschetti E, Achene L, Turrio-Baldassarri L, Ottaviani M, Bogialli S. (2009). Determination of low-level acrylamide in drinking water by liquid chromatography/tandem mass spectrometry. J AOAC Int. 92(1):263-270.
12. Tardiff RG, Gargas ML, Kirman CR, Carson ML, Sweeney LM. (2010). Estimation of safe dietary intake levels of acrylamide for humans. Food ChemToxicol. 48(2):658-657.
13. Tareke E, Rydberg P, Karlsson P, Eriksson S, Törnqvist M. (2002). Analysis of acrylamide, a carcinogen formed in heated foodstuffs.JAgric Food Chem. 50(17):4998-5006.
14. Konings EJ, Baars AJ, van Klaveren JD, Spanjer MC, Rensen PM, Hiemstra M, van Kooij JA, Peters PW. (2003). Acrylamide exposure from foods of the Dutch population and an assessment of the consequent risks.FoodChemToxicol. 41(11):1569-1579.
15. Tyl RW, Friedman MA. (2003). Effects of acrylamide on rodent reproductive performance.ReprodToxicol. 17(1):1-13.
16. Martyniuk CJ, Feswick A, Fang B, Koomen JM, Barber DS, Gavin T, Lopachin RM. (2013). Protein targets of acrylamide adduct formation in cultured rat dopaminergic cells. ToxicolLett.pii: S0378-4274(13)00145-8.
17. Pelucchi C, Franceschi S, Levi F, Trichopoulos D, Bosetti C, Begri E, LaPernice R, Hauder J, Koehler P, Vitaglione P, Fogliano V, Somoza V. (2009). Effect of sulforaphane on glutathione-adduct formation and on lutathione_S_transferase-

dependent detoxification of acrylamide in Caco-2 cells.MolNutr Food Res. 53(12):1540-1550.

18. Rice M J. (2005). "The carcinogenicity of acrylamide", Mutat. Res., 580, 3-20.
19. DiNovi M, Howard D. (2004). The updated exposure assessment for acrylamide. In: Acrylamide in Food: Update—Scientific Issues, Uncertainties, and Research Strategies 2004; FDA/CFSAN.
20. LoPachin RM, Barber DS, Gavin T. (2008). Molecular mechanisms of the conjugated alpha,beta-unsaturated carbonyl derivatives: relevance to neurotoxicity and neurodegenerative diseases.Toxicol Sci.104(2):235-249.
21. Shinomol GK, Raghunath N, Bharath MM, Muralidhara. (2013). Prophylaxis with *Bacopamonnieri* Attenuates Acrylamide Induced Neurotoxicity and Oxidative Damage via Elevated Antioxidant Function. Cent NervSyst Agents Med Chem. 13(1):3-12.
22. Bachmann M, Myers JE, Bezuidenhout BN. (1992). Acrylamide monomer and peripheral neuropathy in chemical workers.Am J Ind Med. 21(2):217-222.
23. Gold B G, Voda J, Yu X, Gordon H. (2004). "The immunosuppressant FK 506 elicits a neuronal heat shock response and protects against acrylamide neuropathy", Exp. Neurol.,187: 160-170.
24. Sadek I A. (1989). Short-term studies of the effect of acrylamide on the testes of the Egyptian toad.FoliaMorphol (Praha). 37(4):427-430.
25. Yang HJ, Lee SH, Jin Y, Choi JH, Han CH, Lee MH. (2005). Genotoxicityand toxicological effects of acrylamide on reproductive system in male rats.J Vet Sci. 6(2):103-109.
26. Song H X, Wang R, Geng Z M, Cao S X and Liu T Z. (2008). "Subchronic exposure top acrylamide effects

reproduction and testis endocrine functions if rats." Zhonghua Nan. Ke. Xue., 14 (5): 406-910.

27. Zhu YJ, Zeng T, Zhu YB, Yu SF, Wang QS, Zhang LP, Guo X, Xie KQ. (2008). Effects of acrylamide on the nervous tissue antioxidant system and sciatic nerve electrophysiology in the rat.Neurochem Res. 33(11):2310-2317.
28. Blasiak J, Gloc E, Wozniak K, Czechowska A. (2004). Genotoxicity of Acrylamide in human lymphocytes. ChemBiol Interact. 149(2-3):137-149.
29. Yousef MI, El-Demerdash FM. (2006). Acrylamide-induced oxidative stress and biochemical perturbations in rats.Toxicology. 219(1-3):133-41.
30. El-Sayed H H, Abd El- Halim S S, Morsy G M and El-Adawi A E. (2007). Alteration of Oxidative Status in Rats Following Administration of Acrylamide.The Egyptian Journal of Hospital Medicine. 28: 397 – 403
31. Ma Y, Shi J, Zheng M, Liu J, Tian S, He X, Zhang D, Li G, Zhu J. (2011).Toxicological effects of acrylamide on the reproductive system of weaning male rats.ToxicolInd Health. 27(7):617-27.
32. Retiman S, Frankel S A (1975). Colorimetric method for determination of serum glutamic oxalo-acetic and glutamic pyruvate transaminases. Am. J. Clin. Pathol., 28: 56-63.
33. Belfield A, Goldberg D M.(1971). Colorimetric determination of alkaline phosphatase activity. Enzyme; 12: 561-568.
34. Ellman G L, Courtney K D, Andres V Jr, Feather-Stone R M (1961). A new and rapid colorimetric determination of acetylcholinesteraseactivity.BiochemPharmacol, 7:88-95.
35. Lowry O H, Rosebrough N J, Farr A L, Randall R J. (1951). Protein measurement with the folin phenol reagent. J. Biol. Chem., 193: 265-275.

36. Ohkawa H, Ohishi N, Yagi K. (1979). Assay for lipid peroxides in animal tissues by thiobarbituric acid reaction. Anal Biochem, 95: 351-358.
37. Aykac M, Uysal M, Yalcin AS, Kocak - Toker N, Sivas N A, Oz H. (1985). The effect of chronic ethanol ingestion on hepatic lipid peroxide, glutathione peroxidase and glutathione transferase in rats. Toxicol., 36: 71-76.
38. Nishikimi M, Appaji N, Yagi K (1972). The occurrence of superoxide anion in the reaction of reduced phenazinemethosulfate and molecular oxygen. Biochem. Bioph. Res. Common 46: 849-854.
39. Van Landingham CB, Lawrence GA, Shipp AM. (2004). Estimates of lifetime-absorbed daily doses from the use of personal-care products containing polyacrylamide: a Monte Carlo analysis.Risk Anal.24(3):603-619.
40. LoPachin RM, Canady RA. (2004). Acrylamide toxicities and food safety: Session IV summary and research needs.Neurotoxicology. 25(4):507-509.
41. Mannaa F, Abdel-Wahhab MA, Ahmed HH, Park MH. (2006). Protective role of Panax ginseng extract standardized with ginsenoside Rg3 against acrylamide-induced neurotoxicity in rats. J ApplToxicol. 26(3):198-206.
42. Whitby H, Gescher A, Levy L. (1984). An investigation of the mechanism of hepatotoxicity of the antitumour agent N-methylformamide in mice.BiochemPharmacol. 33(2):295-302
43. Shuming C, Jilin F, Xichun Z. (2009). The moderating role of dark soy sauce to acrylamide-induced oxidative stress and neurophysiological perturbations in rats.ToxicolMech Methods. 19(6-7):434-440.
44. Rawi S M, Marie M S, Fahmy S R and El-Abied, S A. (2012). Hazardous effects of acrylamide on immature male and female

rats. African Journal of Pharmacy and Pharmacology, 6(18), pp. 1367-1386.
45. Khan IA, Reddy BV, Mahboob M, Rahman MF, Jamil K. (2001). Effects of phosphorothionate on the reproductive system of male rats.J Environ Sci Health B. 36(4):445-56
46. Hardonk MJ, Koudstaal J. (1976). Enzyme histochemistry as a link between biochemistry and morphology.ProgHistochemCytochem. 8(2):1-68.
47. Dearfield KL, Douglas GR, Ehling UH, Moore MM, Sega GA, Brusick DJ. (1995). Acrylamide: a review of its genotoxicity and an assessment of heritable genetic risk.Mutat Res. 330(1-2):71-99.
48. Guo C, Li B, Xiao J. (2010). General survey of mechanisms of acrylamide neurotoxicity. Wei Sheng Yan Jiu. 39(3):282-285.
49. Vikström AC, Wilson KM, Paulsson B, Athanassiadis I, Grönberg H, AdamiHO, Adolfsson J, Mucci LA, Bälter K, Törnqvist M. (2010). Alcohol influence on acrylamide to glycidamide metabolism assessed with hemoglobin-adducts and questionnaire data.FoodChemToxicol. 48(3):820-824.
50. Sweeney LM, Kirman CR, Gargas ML, Carson ML, Tardiff RG.(2010). Development of a physiologically-based toxicokinetic model of acrylamide and glycidamide in rats and humans.FoodChemToxicol. 48(2):668-685.
51. Barber DS, LoPachin RM. (2004). Proteomic analysis of acrylamide-protein adduct formation in rat brain synaptosomes.ToxicolApplPharmacol. 201(2):120-136.
52. Ozkul A, Ayhan M, Yenisey C, Akyol A, Guney E, Ergin FA. (2010). The role of oxidative stress and endothelial injury in diabetic neuropathy and neuropathic pain.NeuroEndocrinolLett. 31(2):261-264.
53. Park HR, Kim MS, Kim SJ, Park M, Kong KH, Kim HS, Kwack SJ, Kang TS, Kim SH, Kim HS, Lee J. (2010).

Acrylamide induces cell death in neural progenitor cells and impairs hippocampal neurogenesis.Toxicol Lett. 193(1):86-93.

54. Lykkesfeldt J, Trueba GP, Poulsen HE, Christen S. (2007). Vitamin C deficiency in weanling guinea pigs: differential expression of oxidative stress and DNA repair in liver and brain.Br J Nutr. 98(6):1116-1119.
55. Zelen I, Djurdjevic P, Popovic S, Stojanovic M, Jakovljevic V, Radivojevic S, Baskic D, Arsenijevic N. (2010). Antioxidant enzymes activities and plasma levels of oxidative stress markers in B chronic lymphocytic leukemia patients.J BUON. 15(2):330-336.
56. Hickling KC, Hitchcock JM, Oreffo V, Mally A, Hammond TG, Evans J G, Chipman JK. (2010). Evidence of oxidative stress and associated DNA damage, increased proliferative drive, and altered gene expression in rat liver produced by the cholangiocarcinogenicagentfuran.ToxicolPathol. 38(2):230-243.
57. Naruszewicz M, Zapolska-Downar D, Kośmider A, Nowicka G, Kozłowska-Wojciechowska M, Vikström AS, Törnqvist M. (2009). Chronic intake of potato chips in humans increases the production of reactive oxygen radicals by leukocytes and increases plasma C-reactive protein: a pilot study.Am J ClinNutr. 89(3):773-777.
58. Sharma M, Vijayaraghavan R, Ganesan K. (2008). Comparison of toxicity of selected mustard agents by percutaneous and subcutaneous routes.Indian J Exp Biol. 46(12):822-830.
59. Oliveira NG, Pingarilho M, Martins C, Fernandes AS, Vaz S, Martins V, Rueff J, Gaspar JF. (2009). Cytotoxicity and chromosomal aberrations induced by acrylamide in V79 cells: role of glutathione modulators.Mutat Res. 676(1-2):87-92.

60. Sumner SC, Williams CC, Snyder RW, Krol WL, Asgharian B, Fennell T R. (2003). Acrylamide: a comparison of metabolism and hemoglobin adducts in rodents following dermal, intraperitoneal, oral, or inhalation exposure.Toxicol Sci. 75(2):260-270.
61. Puppel N, Tjaden Z, Fueller F, Marko D. (2005). DNA strand breaking capacity of acrylamide and glycidamide in mammalian cells.Mutat Res. 580(1-2):71-80.
62. Leibovitz BE, Siegel BV. (1980). Aspects of free radical reactions in biological systems: aging.JGerontol. 35(1):45-56.
63. Gupta M, Mazumder U, Siva Kumar T, Gomathi P, Sambath Kumar R. (2004). Antioxidant and hepatoprotective effects of of*Bauhiniaracemosa* against paracetamol and carbon tetrachloride induced liver damage in rats. Iran J Pharm Therap; 3: 12-20.
64. Catalgol B, Ozhan G, Alpertunga B. (2009). Acrylamide-induced oxidative stress in human erythrocytes. Hum ExpToxicol. 28(10):611-617.
65. Escobar JA, Rubio M A, Lissi E A. (1996). SOD and catalase inactivation by singlet oxygen and peroxyl radicals. FreeRadicBiol Med; 20: 285- 290.

Table (1): Effect of acrylamide administration (15 mg/kg body weight) on the activities of AST, ALT and ALP in the liver tissues of weaning male and female treated rats.

Enzymes	Time periods	Male		Female	
		Control	ACR	Control	ACR
ALT (U/g. tissue)	14 days	1274.6 ± 56.9	1016 ± 93.3*	1114.8 ±60.3	949.66±65.9*
	28 days	1155.5±115.6	849.3 ± 70.3*	1128.1 ±52.2	1011.1 ± 50.1
	withdrawal	1083.6 ± 65.8	1049± 93.5	1052.1 ±66.9	1110.3 ± 51.5
AST (U/g. tissue)	14 days	866.6 ± 32.6	615.0 ± 93.5*	864.6 ± 70.9	453.0 ± 85.0*
	28 days	877.5 ± 67.5	513.5 ± 17.1*	783.0 ± 25.3	660.8 ± 82.5
	withdrawal	807.0 ± 70.5	549.0 ± 72.2*	737.5 ± 41.7	682.5 ± 96.2
ALP (U/g.tissue)	14 days	1419.0 ± 90.3	868.0 ± 123.7*	754.7 ±166.3	395.3 ± 62.1*
	28 days	1248.0 ± 111.1	632.0 ± 104.7*	833.2 ± 53.2	467.3 ± 79.7*
	withdrawal	**1307.0 ± 109.8**	**901.0 ± 90.9***	**791.5 ±105.6**	**539.5 ± 65.3***

All data are mean of six rats ± SEM. Asterisk (*) indicates significant ($P < 0.05$) of acrylamide treatment as compared with the corresponding control.

Table (2): Effect of acrylamide administration (15 mg/kg body weight) on the activity of acetylcholienesterase (AchE) (µ mol SH / min./mg.protein) in the brain tissues of weaning male and female treated rats.

Time periods	Male		Female	
	Control	ACR	Control	ACR
14 days	1.25 ± 0.13	0.92 ± 0.10*	1.05 ± 0.05	0.89 ± 0.09
28 days	1.25 ± 0.14	0.83 ± 0.10*	1.01 ± 0.09	0.85 ± 0.13
withdrawal	1.32 ± 0.05	1.02 ± 0.05*	1.03 ± 0.09	0.93 ± 0.09

All data are mean of six rats ± SEM. Asterisk (*) indicates

significant ($P < 0.05$) of acrylamide treatment as compared with the corresponding control.

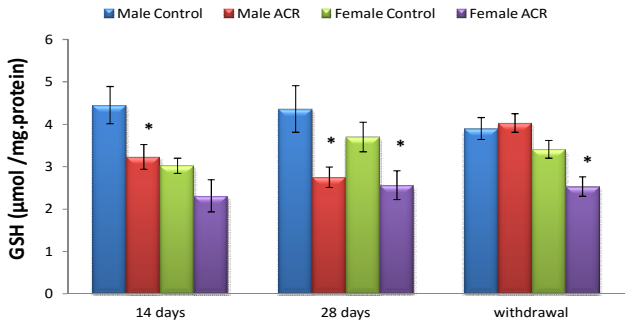

Fig. (2): Effect of acrylamide administration (15 mg/kg body weight) on the glutathione content in the liver tissues of male and female treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

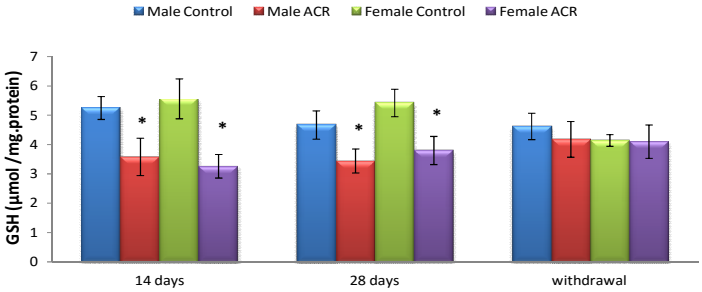

Fig. (3): Effect of acrylamide administration (15 mg/kg body weight) on the glutathione content in the kidney tissues of male and female treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

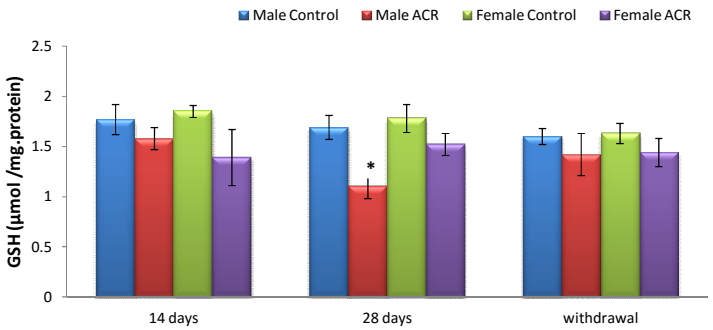

Fig. (4): Effect of acrylamide administration (15 mg/kg body weight) on the glutathione content in the brain tissues of male and female treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

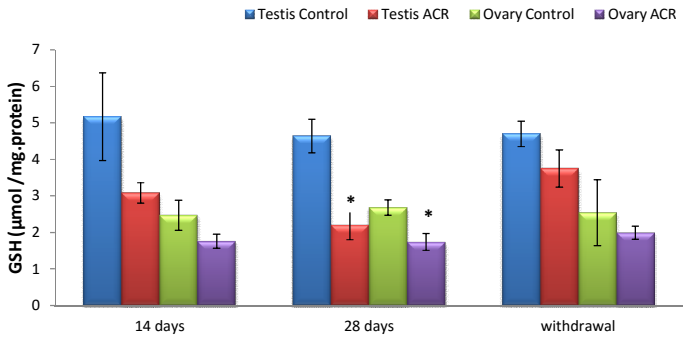

Fig. (5): Effect of acrylamide administration (15 mg/kg body weight) on the glutathione content in the testis and ovary tissues of the treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

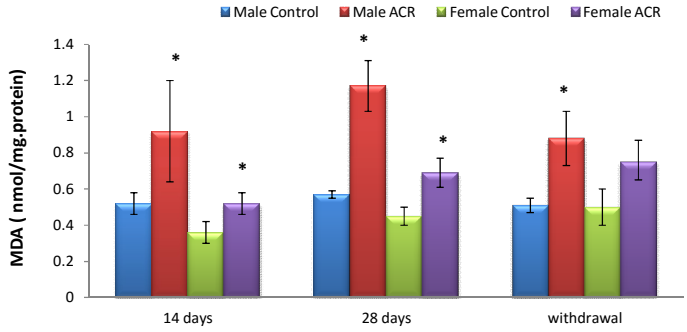

Fig. (6): Effect of acrylamide administration (15 mg/kg body weight) on the MDA content in the liver tissues of male and female treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

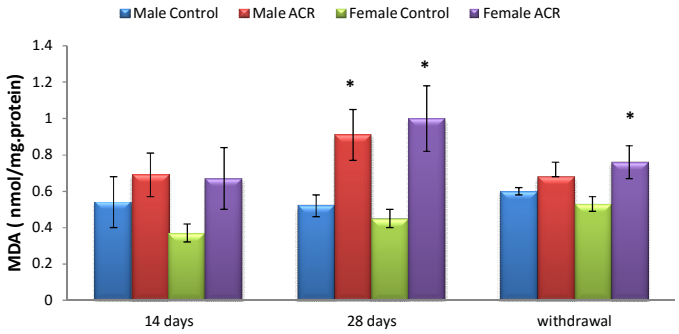

Fig. (7): Effect of acrylamide administration (15 mg/kg body weight) on the MDA content in the kidney tissues of male and female treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

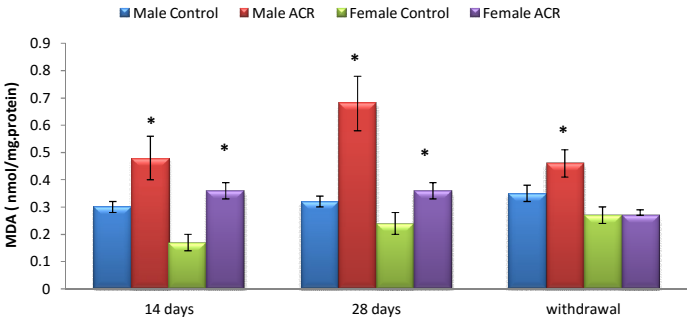

Fig. (8): Effect of acrylamide administration (15 mg/kg body weight) on the MDA content in the brain tissues of male and female treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

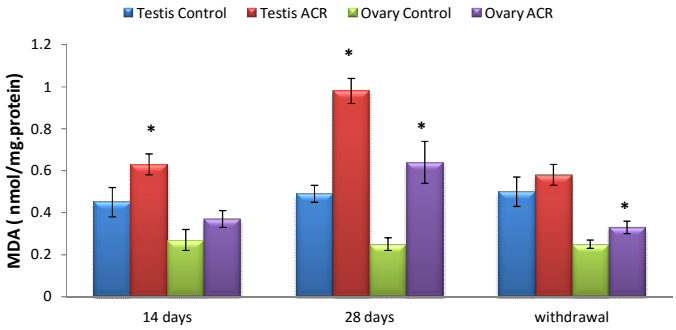

Fig. (9): Effect of acrylamide administration (15 mg/kg body weight) on the MDA content in the testis and ovary tissues of the treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

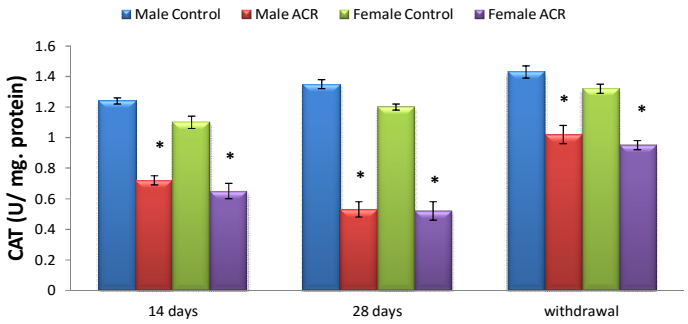

Fig. (10): Effect of acrylamide administration (15 mg/kg body weight) on the CAT activity in the liver tissues of male and female treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

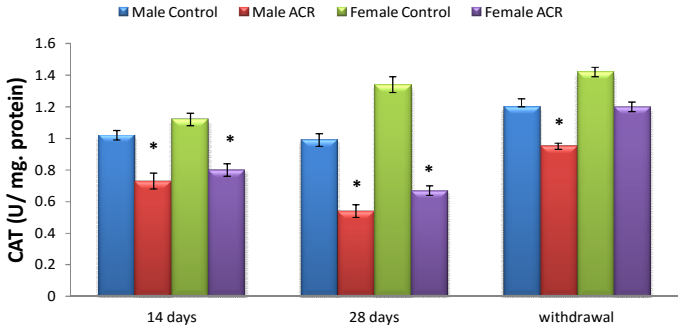

Fig. (11): Effect of acrylamide administration (15 mg/kg body weight) on the CAT activity in the kidney tissues of male and female treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

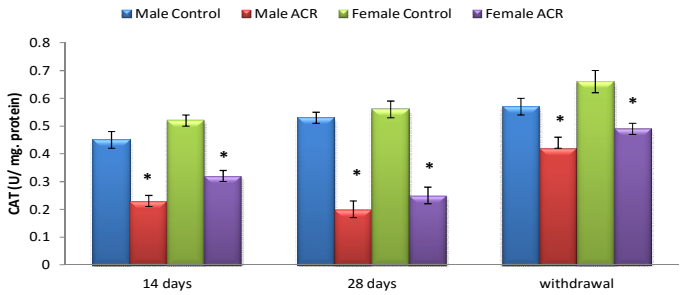

Fig. (12): Effect of acrylamide administration (15 mg/kg body weight) on the CAT activity in the brain tissues of male and female treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

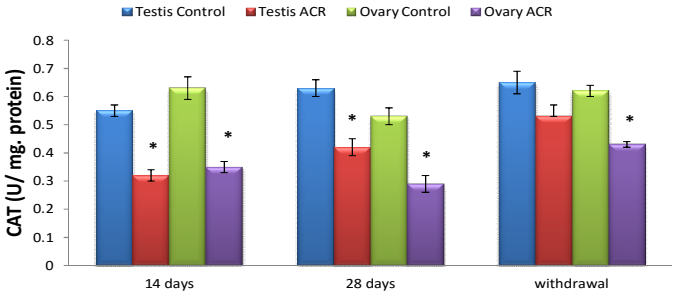

Fig. (13): Effect of acrylamide administration (15 mg/kg body weight) on the CAT activity in the testis and ovary tissues of the treated rats. Each bar represents the mean ± S.E.M. of 6 rats. *P < 0.05.

الفهرس

يشترط في البحوث العلمية المقدمة للنشر أن يراعى فيها ما يأتي :

- أصول البحث العلمي وقواعده .
- ألا تكون المادة العلمية قد سبق نشرها أو كانت جزءا من رسالة علمية .
- يرفق بالبحث المكتوب باللغة العربية بملخص باللغة الإنجليزية ، والبحث المكتوب بلغة أجنبية مرخصا باللغة العربية .
- يرفق بالبحث تزكية لغوية وفق أنموذج معد .
- تعدل البحوث المقبولة وتصحح وفق ما يراه المحكمون .
- التزام الباحث بالضوابط التي وضعتها المجلة من عدد الصفحات ، ونوع الخط ورقمه ، والفترات الزمنية الممنوحة للعديل ، وما يستجد من ضوابط تضعها المجلة مستقبلا .

تنبيهات :

- للمجلة الحق في تعديل البحث أو طلب تعديله أو رفضه .
- يخضع البحث في النشر لأوليات المجلة وسياستها .
- البحوث المنشورة تعبر عن وجهة نظر أصحابها ، ولا تعبر عن وجهة نظر المجلة .

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