Physiological Studies On The Efficacy Of Silymarin As Antioxidant Against The Disorders In Some Blood Constituents Induced By Irradiation In Female Rats.


* Zoology Dept., Faculty of Science, Helwan University.
** Radiation Biology Dept., National Center for Radiation Research and Technology (NCRRT), P.O. Box 29 Nasr City, Cairo.

This work was directed to evaluate the possible role of silymarin (a flavonoid used as antihepatoxic agent) as a prophylactic agent confronting radiation hazard. Eighty female albino rats were selected at the estrous stage and divided into four groups (G1-G4): 1- Control. 2- Whole body γ-irradiated group with two doses 1 Gy and 6 Gy. 3- Silymarin orally administered group (10 mg / 100 g b. wt., twice daily for one week with the last dose 2 hours before blood sampling). 4- Silymarin administered as G3 then rats were irradiated after 2 hours. Blood samples were taken at 2 hours, 2 days and 2 weeks after the last silymarin dose (G3) or irradiation (G2 and G4).

Irradiation induced significant declines in RBCs and WBCs count, Hg content and Hct % denoting a deleterious effect in a dose and time dependent manner. Yet, it produced high levels of plasma malondialdehyde, as the end product of lipid peroxidation, concomitant with reduced levels of blood glutathione indicating a depression in the antioxidant system. Dramatic increments in the plasma indices of liver (ALT, AST and alkaline phosphatase) and kidney (urea, uric acid and creatinine) functions were also recorded depicting a liver and kidney impairment state. Silymarin manifested good amelioration in the radiation-induced changes in the studied parameters. Hence, it could be concluded that silymarin plays a beneficial radioprotective role against radiation hazard in female rats which serves a great sector of women working in radiation application fields or those undergoing radiotherapy.

Introduction

Exposure to ionizing radiation could induce direct and/or indirect effect in the biological system. The depth of penetration of an ionizing radiation depends on the nature of the radiation on one hand and on the composition and density of irradiated substance on the other (Yarmomenko, 1988).

Ionizing radiation injury to living cells is to a large extent, due to induction of free radicals and oxidative stress (Karbownik and Reiter, 2000).

There has been a substantial increase in the use of complementary therapies by patients to manifest the oxidative stress. Although many such modalities are available, herbal therapies are the most popular, and one of these remedies is Silymarin (Bass, 1999). Silymarin (milk thistle) is a mixture of flavonolignans, comprised mainly of three isomers: silybin, silydianin and silychristin extracted from the seeds and fruits of silybum marianum (Quaglia et al., 1999). It has been clinically used largely as an antihepatoxic agent, due to its strong antioxidant activity (Lahiri - Chatterjee...
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et al., 1999). The present investigation has been carried out to study:
1. The hazard effects of exposure to whole-body γ-irradiation on the level of blood glutathione (GSH) as a free radical scavenger, plasma malondialdehyde (MDA) as the main product of lipid peroxidation, some haematological parameters, liver function indices (plasma AST, ALT and alkaline phosphatase), and kidney function indices (plasma urea, uric acid and creatinine) in female rats.
2. The possible prophylactic role of silymarin in confronting γ-irradiation sickness.
3. The evaluation of both the early and delayed effects of γ-radiation at the low and high doses.

Material and Methods
In this study eighty adult female albino rats weighted about 150 ± 50 g were used. They were obtained from the animal house of the Biological Applications Dept., Nuclear Research Center, Inshas. Rats were housed in plastic cages, under normal temperature, pressure, humidity and good ventilation and illumination conditions, watered and fed with access of standard granulated chow.

All females were selected at the oestrus stage. Cycle stages were assessed by daily inspection of vaginal smear cytology.

Experimental design:
Animals were categorized into four main groups as follows:
1- Control group (5 rats).
2- Whole body gamma irradiated group (30 rats) subdivided into two subgroups: A- irradiated with 1 Gy. B- irradiated with 6 Gy.
3 - Silymarin injected group (15 rats).
4 - Silymarin injected then irradiated group (30 rats) subdivided into two subgroups similar to group (2).

Treatments:
1- Irradiation: Whole-body gamma irradiation at two dose levels 1 Gy and a sub-lethal dose 6 Gy (groups 2 and 4) was performed using a ventilated Cesium –137 Gamma Cell-40 manufactured by the Atomic Energy of Canada Limited (AECL) belonging to the NCRRT. The unit provides a mean for uniform gamma irradiation of small animals at a dose rate 1 Gy /1.2 min. at the experimentation time.
2- Silymarin Injection: Animals of both groups three and four were administered orally with silymarin produced by South Egypt Drug Industries company (SEDICO) at a dose level 10 mg / 100 g body weight dissolved in distilled water. Silymarin was injected twice daily for one week with the last injection two hours before blood sampling (group 3) and two hours pre-irradiation (group 4).

Blood sampling and time intervals:
All animals were anaesthetized with chloroform and blood samples were collected by heart puncture in centrifuge tubes containing EDTA at three time intervals: two hours, two days and two weeks after the last silymarin dose injection (group 3) or after irradiation (group two and four). A part of fresh blood samples was used for the investigation of blood picture parameters (haemoglobin, haematocrit %, total erythrocytic count and total leucocytic count) according to Dacie and Lewis (1991), and for the determination of blood glutathione content according to Beutler et al. (1963). The second part of blood was centrifuged and the separated plasma was used for the evaluation of malondialdehyde according to Yoshioka et al. (1979) and the determination of liver function (ALT, AST and alkaline phosphatase) and kidney function (urea,
uric acid and creatinine) indices using biochemical kits manufactured by Diamond Diagnostic (Egypt) and Biocon (Germany) companies.

Comparison of the means and statistical analysis were performed using paired Student t-test according to Snedecor and Cochrn (1989).

Results

1- Haematological Parameters:

Figure (1) in the present study summarized the effect of irradiation and / or silymarin administration on blood haemoglobin, haematocrit %, total erythrocytic count and total leucocytic count. The figure illustrated that exposing rats to both doses (1Gy and 6 Gy) $\gamma$- irradiation resulted in statistically significant (P < 0.05 - 0.001) decrease in all the examined parameters except for the significant increase (P < 0.001) in blood haematocrit % recorded at 2 hours time interval as compared to control value. The most drastic decrease occurred at two weeks after the higher dose level (6 Gy). The oral administration with silymarin did not show any significant differences as compared to control group, except for the recorded decrease in Ht % (-11.3 %, P < 0.01) at 2 hrs post administration and the decrease in total leucocytic count recorded after two weeks (-9.8 %, P < 0.01). It's administration prior to irradiation significantly improved to a large extent (P < 0.05 - 0.001) the decrements in all the measured parameters induced by irradiation at both doses (1 and 6 Gy).

2- Biochemical Parameters:

A- Lipid Peroxidation [Plasma Malondialdehyde (MDA)]:

The data obtained in the present study (Table 1) indicated that the exposure to irradiation showed a pronounced significant elevation began after 2 days at 1 Gy and after 2 hours at 6 Gy and reached its maximum level (about 52.5 % from control value) after 2 weeks. No significant alterations in plasma MAD levels were observed after silymarin administration alone. While, when it administered one week prior to irradiation a significant reduction (P < 0.001) of MDA levels was noticed at all time intervals versus control value and versus the irradiated group.

B- Blood glutathione content (GSH):

A dramatic and gradual significant decrease in GSH blood levels of group (2) exposed to both irradiation doses (1 Gy & 6 Gy) was depicted in Table (1). Administration of silymarin for one week increased significantly blood GSH content at 2 hours (4.3 %), 2 days (14.5 %) and extended till 2 weeks (22.6 %) time interval as compared to control value. When it was administered before irradiation 1Gy & 6 Gy it improved significantly the decrease in blood GSH levels induced by irradiation even than the control level.

C- Liver Function Indices (Plasma ALT, AST and Al Ph):

Exposure of female rats to both dose levels (1Gy and 6 Gy) $\gamma$-irradiation induced statistically significant (P < 0.001) elevation in ALT, AST and Al Ph levels in plasma as a dose dependent manner when compared to control rats. The oral administration with silymarin showed a significant increase in ALT plasma level after 2 hours and 2 days. No significant changes were recorded in AST plasma levels, whereas, it significantly decreased Al Ph plasma level at 2 hr time interval as compared to control level. Furthermore, silymarin administration prior to irradiation significantly ameliorated the increase induced by $\gamma$-irradiation (Table 2).
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D - Kidney Function Indices (Plasma Urea, Uric Acid and Creatinine Levels):

Exposure of rats to both doses 1 Gy & 6 Gy γ-irradiation induced a gradual significant increase in plasma levels of urea, uric acid and creatinine at all time intervals in a dose dependent manner. Silymarin administration alone showed no significant changes on urea level in plasma at 2 hours and 2 days, but it significantly decreased it after 2 weeks than the control value. A similar significant decline was observed in plasma levels of uric acid and creatinine after 2 days and 2 weeks as compared to control levels. Administration of silymarin before irradiation showed a prophylactic effect since it significantly (P < 0.001) improved the elevations in urea, uric acid and creatinine plasma levels induced by γ-irradiation as depicted in table 3.

Table 1: Effect of Gamma Irradiation (1 Gy and 6 Gy) and Silymarin Oral Administration (10 mg / 100 g b. wt.) on Plasma Levels of Malondialdehyde (MDA) and Blood Glutathione (GSH) in Female Albino Rats.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Time intervals</th>
<th>Control</th>
<th>Irradiated 1 Gy</th>
<th>Silymarin Admin.</th>
<th>Sil. Admin. + Irrad.</th>
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<td>6 Gy</td>
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<td>2 hours</td>
<td>Plasma MDA (mM)</td>
<td>76.32 ± 1.02</td>
<td>73.36 ± 1.04</td>
<td>87.92 ± 0.87</td>
<td>75.32 ± 1.73</td>
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<td>2 days</td>
<td>Blood GSH (mg/dl)</td>
<td>66.7 ± 0.87</td>
<td>49.6 ± 0.08</td>
<td>37.39 ± 0.62</td>
<td>69.58 ± 0.3</td>
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<td>2 weeks</td>
<td>Blood GSH (mg/dl)</td>
<td>66.7 ± 0.87</td>
<td>46.68 ± 1.01</td>
<td>26.94 ± 1.2</td>
<td>76.43 ± 2.04</td>
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<td>a***, c***</td>
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Each value represents mean ± SE, n = 6, * - *** = P < 0.05 - 0.001
Table 2: Effect of Gamma Irradiation (1 Gy and 6 Gy) and Silymarin Orally Administration (10 mg/100 g b. wt.) on Plasma Levels of ALT (U/L), AST (U/L) and Alkaline Phosphatase (U/L) in Female Albino Rats.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Time intervals</th>
<th>Control</th>
<th>Irradiated 1 Gy</th>
<th>Silymarin Adm.</th>
<th>Sil. Admin. + Irrad.</th>
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<td>1 GY</td>
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<td>6 Gy</td>
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<td>2 hours</td>
<td>28.74 ± 0.2</td>
<td>41.41 ± 0.3</td>
<td>30.70 ± 0.13</td>
<td>36.86 ± 0.71</td>
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<td>2 days</td>
<td>30.26 ± 0.53</td>
<td>49.29 ± 0.76</td>
<td>30.06 ± 0.17</td>
<td>37.27 ± 0.21</td>
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<td>2 weeks</td>
<td>33.44 ± 0.91</td>
<td>50.27 ± 0.23</td>
<td>25.43 ± 0.22</td>
<td>27.81 ± 0.3</td>
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<td>2 hours</td>
<td>117.2 ± 0.36</td>
<td>124.44 ± 0.3</td>
<td>69.42 ± 0.25</td>
<td>72.79 ± 0.41</td>
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<td>a***</td>
<td>a***,c***</td>
<td>69.42 ± 0.25</td>
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<td>2 days</td>
<td>116.74 ± 0.35</td>
<td>117.71 ± 1.27</td>
<td>69.88 ± 0.18</td>
<td>71.99 ± 0.46</td>
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<td>69.88 ± 0.18</td>
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<td>2 weeks</td>
<td>120.85 ± 1.2</td>
<td>123.39 ± 0.53</td>
<td>69.83 ± 0.46</td>
<td>71.4 ± 0.59</td>
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<td>69.83 ± 0.46</td>
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<td>2 hours</td>
<td>27.15 ± 2.27</td>
<td>33.08 ± 1.06</td>
<td>20.18 ± 1.09</td>
<td>37.3 ± 2.05</td>
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<td>20.18 ± 1.09</td>
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<td>2 days</td>
<td>59.53 ± 1.06</td>
<td>37.08 ± 1.23</td>
<td>25.74 ± 1.8</td>
<td>44.09 ± 3.84</td>
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<td>2 weeks</td>
<td>48.36 ± 1.23</td>
<td>27.27 ± 0.99</td>
<td>26.36 ± 2.03</td>
<td>54.36 ± 1.01</td>
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a = significantly different as compared with control group.
b = significantly different as compared with 2 hours time interval in the same group.
c = significantly different as compared with 1Gy dose level at corresponding time interval within the same group.
d = significantly different as compared with corresponding time interval in irradiated group. Each value represents mean ± SE, n = 6, * - *** = P < 0.05 - 0.001
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**Table 3:** Effect of Gamma Irradiation (1 Gy and 6 Gy) and Silymarin Orally Administration (10 mg / 100 g b. wt.) on Plasma Levels of Urea (mg / dl), Uric acid (mg / dl) and Creatinine (mg / dl) in Female Albino Rats.

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<td>38.42 ± 1.2</td>
<td>49.17 ± 1.15</td>
<td>a***, c***</td>
<td>35.73 ± 0.49</td>
<td>37.92 ± 1.02</td>
<td>47.17 ± 1.28</td>
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<td>35.68 ± 0.81</td>
<td>41.13 ± .45</td>
<td>53.7 ± 1.45</td>
<td>a***, b***</td>
<td>40.05 ± .005</td>
<td>49.28 ± 1.04</td>
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<td>46.94 ± 0.19</td>
<td>57.33 ± 0.66</td>
<td>a***, b***, c***</td>
<td>43.62 ± 1.46</td>
<td>55.46 ± 0.34</td>
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<td>38.70 ± 0.28</td>
<td>41.3 ± 0.34</td>
<td>a***, c***</td>
<td>10.01 ± 0.31</td>
<td>5.61 ± 0.22</td>
<td>15.67 ± 0.61</td>
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<td>19.39 ± 0.29</td>
<td>28.8 ± 0.54</td>
<td>a***, b***, c***</td>
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<td>17.6 ± 0.41</td>
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<td>21.98 ± 0.28</td>
<td>32.16 ± 0.34</td>
<td>a***, b***, c***</td>
<td>5.76 ± 0.23</td>
<td>18.75 ± 0.27</td>
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<td>1.76 ± 0.08</td>
<td>3.23 ± 0.01</td>
<td>a***, c***</td>
<td>1.75 ± 0.05</td>
<td>1.83 ± 0.02</td>
<td>2.67 ± 0.01</td>
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<td>2.02 ± 0.04</td>
<td>3.28 ± 0.04</td>
<td>a***, b***, c***</td>
<td>1.53 ± 0.01</td>
<td>2.02 ± 0.01</td>
<td>2.82 ± 0.01</td>
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<td>2.14 ± 0.07</td>
<td>3.52 ± 0.03</td>
<td>a***, b***, c***</td>
<td>1.28 ± 0.02</td>
<td>1.84 ± 0.09</td>
<td>3.04 ± 0.02</td>
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a = significantly different as compared with control group.
b = significantly different as compared with 2 hours time interval in the same group.
c = significantly different as compared with 1Gy dose level at corresponding time interval within the same group.
d = significantly different as compared with corresponding time interval in irradiated group.

Each value represents mean ± SE, n = 6, * - *** = P < 0.05 - 0.001
Results of the present study revealed that whole body γ-irradiation at 1 Gy and 6 Gy produced substantial disorders began as an early effect even at 2 hours post exposure and extended 2 weeks later. These were evident from the remarkable drop in all the examined haematological parameters (Hg, Ht %, RBCs and WBCs count) which came in accord with the findings of several investigators (Tomatsu, 1992; Hassan et al., 1996 and Abou-Safi, 1998). The noticed decrease was exaggerated with the elapse of time (from 2 hr to 2 wk) and with the high dose (6 Gy) rather than the relatively low dose (1 Gy) as showed in figure 1. This could lead to the assumption that γ-irradiation effect is a time and dose-dependent. This assumption confirmed the findings of Kim et al. (1998) who reported that mice irradiated at the dose 8 Gy

**Discussion**

Figure 1: The percentage changes from control values of blood haemoglobin (g/dl), haematocrit %, RBCs (10⁶/mm³) and WBCs (10³/mm³) count induced by gamma irradiation (1 Gy and 6 Gy) and silymarin orally administration (10mg/100 gb. wt.) in female albino rats.
exhibited time-related decreases in the WBCs, RBCs and platelet counts with maximal reduction noted at day 10.

The recorded drop in haemoglobin concentration that reached – 38.1% of change as compared to control level two weeks after exposure to 6 Gy could be related to haemorrhagic effects of γ-rays (Meky et al., 1994). The most expressed drop in RBCs count (about 38.09% of change from control value) as recorded two weeks after 6 Gy γ-irradiation could be explained by: a- increased destruction of mature erythrocytes (Roushdy et al., 1979); b- diminished ability of blood forming organs to produce their cells; c- thrombogenesis damage (Hassan et al., 1994); d- increased permeability of erythroid cells membrane in the hemolytic process and the erythrocyte membrane stability (Nikishkin et al., 1992). All these factors could be reasonable for the decrease in both RBCs and Hct value, in addition to the possible effect of irradiation on the circulating level of erythropoietin either directly or indirectly as a result of the renal failure or the impairment in the kidney function recorded in the study.

The observed decline in the total leucocytic count after gamma irradiation exposure runs in full agreement with Roushdy and Ashry (1979), Tomatsu (1992) and Hassan et al. (1996). This decline could be attributed to: 1- a decrease in lymphocytes and neutrophils (Moss et al., 1979); 2- mitotic inhibition of the bone marrow precursors (Abdel-Rahman, 1985); 3- hypopcellularity in hemopoietic stem cells and the function of stromal cells (Qing-Xi et al., 1989).

The obtained results showed that exposing rats to the two dose levels (1Gy & 6 Gy) produced high levels of plasma malondialdehyde accompanied by a remarkable reduction in blood glutathione content monitoring the extent of the biological damage induced by irradiation represented by increased lipid peroxidation and depression of the antioxidant system. These results come in good accordance with many previous findings (Seino and Noritaka, 1995; Abu-Ghadeer et al., 1999; Saada et al., 1999 and Ibrahim, 2001). An evidence was provided (Gatske et al., 1990) that the decrease of antioxidant enzyme activities and the increase in free radicals may be the main cause of irradiation induced peroxidation, damage of cell activities and disorders in bio-oxidases activities (Zheng et al., 1996). Moreover, it was reported by Vladimirov (1998) that after radiation exposure, the predominant free radicals showed imbalance with the antioxidant system which became inactivated leading to the formation of lipid peroxidation. Recently, Abou-Safi and Ashry (2003) recorded that whole body single (9 Gy) and fractionated (1.5 Gy x 6) γ-irradiation agitated marked oxidative stress represented by significant increase in MDA concomitant with a reduction in GSH content of both plasma and RBCs.

Whole body γ-irradiation in this study resulted in significant increments in plasma ALT, AST and alkaline phosphatase. These findings run in full agreement with previous ones (Geraci et al., 1993; Donnadieu-Claraz et al., 1999; Abou-safi, 1998 and Abdel-Fattah et al., 1999). These increments in plasma enzymes reflected clearly the lesions occurred in liver function after its cellular damage and consequently the elaboration of its intracellular enzymes into the blood stream (Hassan et al., 1994). These recorded elevations could be also due to a hypoxia state in the parenchymal liver cells and increased permeability of cell membrane (Ghanem, 1984) or
mitochondrial membrane (Todorov and Daminov, 1985) causing the release of intracellular enzymes into circulation. Another explanation could be due to leakage of hydrolases from lysosomes and increasing of lysosomal enzyme activities in liver tissues (El-kashef et al., 1989 and Cornelissen & Ridder, 1990). In addition, Geraci and Mariano (1996) recorded that the leakage of AST from liver slices in vitro correlated with the AST leakage from irradiated liver into the plasma in vivo, indicating hepatocyte membrane damage induced by irradiation. The destruction in liver cells also could refer to the increments in lipid peroxidation and the depression in antioxidant defense in liver cells. Relying on Oser (1979) that myocardium, liver, kidney parenchyma and red blood cells are richer in transaminases than other body tissues. Alternatively, destruction and necrosis of any of these tissues lead to the release of large amounts of enzymes into the serum. This coincides with the decrease obtained in the studied haematological picture due to the destruction of cells induced by irradiation promoting the liberation of these enzymes with high levels in blood. The increase in liver enzymes, in the present study, was developed with the elapse of time, which came in accordance with Prasad (1984), who found that activation of lysosomal activity does not occur immediately after irradiation, but it develops progressively as a function of post irradiation time.

The current study depicted that γ-irradiation either at low dose level (1Gy) or at a sub-lethal one (6 Gy) induced significant increase in the plasma levels of the non-protein nitrogen compound represented by urea, uric acid and creatinine, as indices for kidney function. These results came similar to previous investigations by EL-Kashef and Saada (1988) at the dose level 5.5 Gy, Konnova et al. (1991) at 8.5 Gy and Abou-Safi (1998) at 6 Gy dose level of γ-irradiation. These increments could be considered as a reflection of deteriorating renal performance (Geraci et al., 1990) due to the ammonia formed by deamination of amino acids in the liver which converted to urea (Ganong, 1999) or to increased breakdown of nucleic acids (Yarmonenko, 1988). Since irradiation may cause breaking of DNA molecules and destruction of their bases (the purines) which may be catabolized into uric acid (Ganong, 1999). As creatinine is formed largely in muscles and occurs freely in blood plasma and urine, its increased levels in plasma serve as an index of renal function impairment (Farag, 1994).

Silymarin has been clinically used largely as anti-hepatoxic agent due to its strong antioxidant activity (Lahiri-Chatterjee et al., 1999). In the current work, silymarin was used to study its possible prophylactic role in confronting radiation hazard. It’s administration twice daily for one week, with the last dose two hours before radiation exposure, induced amelioration and even normalization of all the measured parameters extended to two weeks post irradiation. These results are well correlated to other findings (Hakova and Misurova, 1993, Kropacova et al., 1998 and Abu-Gadeer et al., 2001). Silymarin induced increases in patient serum levels of GSH, GSH-peroxidase and superoxide dismutase activity as recorded by Wellington and Jarvis (2001). The mechanisms of silymarin action could be attributed to different biochemical events such as the stimulation of the synthetic rate of ribosomal RNA (rRNA) species through stimulation of polynarase I and rRNA transcription,
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protecting the cell membrane from radical induced damage. It also influences certain metabolic processes including RNA synthesis and stabilizes cell membranes (Hakova et al., 1992). Its inhibitory effect in vivo on radiation, induced deactivation of enzymes and peroxidation of membrane lipids in rat liver microsomes (Gyorgy et al., 1992). The radioprotective effect of silymarin as a potent flavonoid may be attributed to the hydroxyl radical scavenging potency in a directed or an endogenous enzyme mediated manner (Shimoi et al., 1994).

Kropacova et al. (1998) examined the radioprotective and therapeutic effect of silymarin on development and repair of latent injury in rat liver by its application during the continual gamma irradiation (6 Gy / day or acute dose). It showed a curative effect especially after 14 days of its post radiation application. The therapeutic effect of silymarin as a hepatoprotective drug was investigated in rats after total body γ-irradiation with a dose of 6 Gy (Hakova and Misurova 1996). Recently, Wellington and Jarvis (2001), recorded that silymarin improved liver function indices (AST, ALT, gamma-glutamyl transferase and bilirubin) in patients with liver disease of various aetiology, including those exposed to toxic levels of toluene or xylene.

In the present study, female rats were examined daily for estrous cycle stages and selected at the estrous stage as the day suitable for exposure to whole body γ- irradiation and blood sampling at 2 hours time interval followed by the meta-estrous and diestrous stages at which blood samples were taken at 2 days, as well as, after 2 weeks at the same stages. This choice depends on avoiding the pro-estrous stage preceding the estrous stage, at which the plasma estrogen reaches its maximum level in early afternoon (Stoklosowa and Szolty, 1978), then a decrease is reported after 16.00 pm (Shaikh, 1971), followed by gradual decrease till the estrus stage (De Hertogh 1973), at which ovulation occurs and enhanced the secretion of progesterone (P4) i.e. the leutinization process. Yet, it was noticed from some epidemiologic observations that the highest incidence for tumorigenesis of mammary gland by irradiation arose in rats on diestrus in minimum level of ovarian hormones (Hirosh, 1992). Therefore, this choice came to produce the most possible protection with the minimum possible interference, since the study on female rats serves a great sector of women working in radiation application fields or those undergoing radiotherapy. Moreover, the study promotes the usage of silymarin as a useful protector against environmental stresses.

References
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44. Saada, H. N., Azab, Kh. Sh., Said, OZ., Mohamed, M.A., and Abbad,
دراسات فسيولوجية على كفاءة السيليبرامين كمضاد للأكسدة ضد بعض الاختلالات المحدثة بالإشعاع في مكونات الدم إناث الجرذان.

محمد السيد الجابري* - حكمت محمد أبو صافي** - نبيل أحمد

الينائي* - جيهان رشدي عبد الحميد**

قسم علم الحيوان - كلية العلوم - جامعة حلوان

قسم البيولوجيا الإشعاعية - المركز القومي لبحوث وتقنية الإشعاع - هيئة الطاقة الذرية

بعد السيليبرامين مادة طبيعية ويصنف ضمن عائلة "الفلافونويدز". "Silibum marianum" من نبات "سيليبام ماريانام" كما أنه يستخدم طبياً لعلاج أمراض الكبد "الالتهاب والتسمم الكبدى". وقد تم اختيار مادة السيليبرامين لدراسة تأثيرها ودورها الوقائي ضد الضرر الناجم عن التعرض للإشعاع على فترات متفاوتة وجرعتين مختلفتين على بعض التغيرات الفسيولوجية في إناث الجرذان.

تم اختيار ثمانون جرذ أبيض أثني في مرحلة "الشهاج". وتم تقسيمهم إلى أربعة مجموعات: 1- مجموعة ضيقة  2- مجموعة مشعة كلياً بجرعتين من أشعة جاما (1 جرام و 6 جرام) بمعدل تشيع: جرام / 1.2 دقيقة. 3- مجموعة تم إعدادها عن طريق الفم بالسليبرامين (10 مجم / 100 جم من وزن الجسم) مرتين يومياً لمدة أسبوع و آخر جرعة قبل ساعتين من أخذ عينات الدم. 4- مجموعة تم إعدادها بالسليبرامين مثل المجموعة السابقة ثم تم تشيعها باشرعة جاما (1 جرام و 6 جرام) بعد ساعتين من آخر جرعة للسليبرامين. وقد تم أخذ عينات الدم من القلب على ثلاث فترات: بعد ساعتين وثورتين وأسبوعين من آخر جرعة للسليبرامين (المجموعة الثالثة) أو التشيع (المجموعة الثانية والرابعة).

وقد أحدث التشيع نقصاً معنوياً في العد الكلي للكريات الدم الحمراء والبيضاء ومحتوي الدم من البيلوميرون والنسبة المنوية للهيماتوكريت بكيفية تدل على أن التأثير الضار للإشعاع قد إزداد بزيادة الوقت والتشيع. أما أحداث الإشعاع فقد أحدثت مضاعفات وظائفية في مستوى الخلايا من المانكلا دنا الدهادات مصحوبة بنقص معنوي في مستوى الجلوكاتيون دلالة على انخفاض في الجهاز الدافع (الجهاز المعضد للأكسدة) بالكامل. كما قد أحدثت مشاكل اليرقات وظائف كل من الكبد (البوريا ALT, AST) والكيراتينات وحمض البوليك زيادة معنوية مشتركة إلى حدوث اختلافاً في وظائفهما.

وقد أظهرت الدراسة أن السيليبرامين أحدث تحسناً جوهرياً في العلاجات البيولوجية التي مضررت نتيجة المعاملة بالإشعاع. وعليه فهمي القول بأن السيليبرامين يلعب دوراً وقائياً فعالاً للإناث المعرضة للإشعاع سواء كعاملات أو متلقيات للعلاج بالإشعاع.