Antihepatotoxic potential of ginseng (Panax ginseng) in thioacetamide-induced acute hepatocellular injury in rats

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Abstract

Previous studies demonstrated the hepatotoxicity of thioacetamide (TAA) in rats. The present study is a trial to decline TAA-hepatotoxicity by using the roots of herbal medicinal plant (Panax ginseng) pre-treatment.

Low dose of TAA (50-mg/kg b.wt) was chosen to induce hepatotoxicity in male rats previously treated with ginseng for 10 consecutive days. The tested parameters were studied after 24, 48 and 72 hours post TAA intoxication. Fluctuations of serum glucose were noticed in TAA intoxicated rats increased after 24 h (+ 9.31%), 48h. (+ 7.11%), followed by moderate improvement after 72 h. (+5.39%) when compared with control group. Ginseng pretreatment enhanced these changes towards the normal values.

Serum and liver enzyme activities (AST, ALT, ALP and γ GT) increased in TAA intoxicated rats which peaked after 48 h, and began to decrease after 72h. Pretreatment with ginseng improved enzyme activities to some extent.

Reduced glutathione (GSH) as well as antioxidant enzyme glutathione reductase (GSH-R) activity while lipid peroxidation (LPO) increased in TAA intoxicated rats and enhanced by pretreatment with ginseng.

This results suggest that pretreatment with ginseng could improve the detoxifying activity of the liver rats with TAA-induced acute hepatotoxicity.

Key words: Liver toxicity- Thioacetamide- Ginseng, Liver Function - Liver antioxidant - Lipid peroxidation.

Introduction

Panax ginseng (roots) are widely used for medicinal purposes, often without having been prescribed by a physician. It has been used in folk medicine against liver complaints. Ginseng is a potent antioxidant which reduce tissue damage induced by free radicals (Sohn et al., 1993 and Kitts et al., 2000). It has been reported that ginseng can increase body resistance to many harmful factors and protect tissues from damage caused by stress (Liu et al., 1995). Moreover, it has a beneficial effect on various hematological parameters (Ferrando et al.,1999). It helped to delay experimentally-induced heart mitochondrial impairment and muscle contraction deterioration (Tohn, 1994), as well as, it prevented myocardial schema - reperfusion damage in rats (Maffei-facino et al., 1999).

The most important part of ginseng is the root. The chemical constituents of this plant root are arabinose, comphore, mucilage, resin, starch and saponins (FDA, 1999). The root of ginseng contains more than 18 saponins which are considered as the active fractions of ginseng. The majority of them can classified to 2 groups panaxadiol which differ in sugar moiety at the position of carbon 3-6 and 20 (Sanada et al., 1974 and Shoji, 1974). The most important
ingredients in ginseng are ginsenosides. A second group compounds called panaxanes appeared to reinforce the immune system and help to keep blood sugar level under control.

Additionally, Panax ginseng is free from any harmful effects (Sanada et al., 1974 and Aphale et al., 1998), also, there is no known drug interactions with ginseng (FDA, 1999).

Thioacetamide (TAA) is a well known hepatoxin and carcinogen. Its acute administration produces centrilobular liver necrosis. Studies on the mechanism of development of the TAA induced injury revealed that TAA is metabolized by microsomal cytochrome P$_{450}$- dependent and/or, non-P$_{450}$ dependent mixed function oxidases to toxic metabolites capable of forming irreversibly bound products with tissue macromolecules. This may initiate disturbances in hepatic cellular function resulting in cell death (Hunter et al., 1977; Porter et al., 1979, de Ferreyra et al., 1982 and Nikolaev et al., 1986). The slowly developing cirrhosis induced by TAA has proven to be morphologically well defined and uniform, and also appears to reflect the major features of human disease (Zimmermann et al., 1987). Mangipudy et al., 1995a & 1996 and Rao et al., 1996) indicated that low to moderate doses of TAA and CC14 cause hepatic necrosis but simultaneous tissue repair response stimulated in the liver leads to regression of liver injury and recovery. Studies of Ramaiah et al. (1998) showed that in TAA-intoxicated rats, hepatic necrosis was evident at 12 h, peaked at 36 h, persisted up to 72h and was resolved by 96h. Liver damage in hepatocytes from newly weaned rats, treated with sublethal dose of TAA, detected by the decreased levels of glutathione and protein-thiol groups (47% and 52% vs. untreated, respectively) and by enhanced malondialdehyde production (334%) Sanz et al. (1998). Previous study of Sanz et al. (1995) revealed that catalase and glutathione peroxidase, the two enzymes involved in the elimination of peroxides and glutathione reductase decreased significantly at the end of the 6 months of TAA-intoxication.

The objective of this study was to investigate the possible ant hepatotoxic potential of ginseng in thioacetamide induced acute hepatocellular injury particularly on liver function antioxidants and lipid peroxidation.

**Material and methods**

Sixty four male albino rats weighting 250-275 g were included in this study, rats were divided into 8 groups each group contained 6 rats and served as follows:

**Group 1**: Control (C).

**Group 2**: (G) treated orally with Panax ginseng root powder in dist water (117 mg/kg) for 10 days.

**Group 3**: Injected ip. with (50 mg/kg) TAA and dissected after 24 h (TA24).

**Group 4**: Treated with (50 mg/kg) TAA (as group 3) pretreated with Panax ginseng (as group 2) and dissected after 24 h (G + TA24).

**Group 5**: Treated with (50 mg/kg) TAA (as group 3) and dissected after 48 h (TA48).

**Group 6**: Treated with (50 mg/kg) TAA (as group 3) and pretreated with ginseng (as group 2) and dissected after 48 h (G + TA48).

**Group 7**: Treated with (50 mg/kg) TAA (as group 3) and dissected after 72 h (TA72).

**Group 8**: Treated 50 mg/kg TAA (as group 3) and pretreated with panax ginseng (as group 2).

The dose of panax ginseng root powder was 117 mg/kg, it was used freshly suspended in distilled water and it was given by stomach tube. Powder of panax root (aqueous extract). Was obtained from IPECO company.

For physiological measurements, blood was collected by scarifying through jugular vein in a clean dry centrifuge tubes, kept for 30 min. at 37 °C and centrifuged at 3000 rpm for 15 min. The sera were collected in a clean Epindorf tubes and kept at -20°C until analysis.

**Tissue sampling:**

Liver was removed and the weight was record, then homogenatated in 4
Antihepatotoxic potential of ginseng

... volumes of ice cold 20 mM tris HCl buffer (PH 7.2) containing 0.15 M KCl. The homogenate was centrifuged at 3000 rpm for 10 minutes and the supernatant was immediately used for enzymatic assays.

The aspartate aminotransferase (AST), alanine aminotransferase (ALT), γ-glutamyl transferase (γ GT), alkaline phosphatase (ALP), glucose in serum and liver fresh tissue (AST), liver fresh tissue (ALT), and liver fresh tissue (ALP) were measured biochemically using test kits of Stanbio. Serum (AST) and (ALT) were determined according to Reitman and Frenkel (1957). Serum (ALP) activity was determined according to Moss (1984). γ-glutamyltransferase (γ -GT) was determined according Persijn and Vander Slik (1976). Glucose was detected by using glucose oxidase according to Howanitz and Howanitz (1984). Natural liver antioxidant glutathione, (GSH) content was determined according Prins and Loose (1969) and glutathione reductase (GSSGR) activity was determined by the method Beutler (1975). Lipid peroxidation (Lpo) product (MDA) was estimated according to Strov and Makarova (1988).

Results

As shown in table (1) serum glucose in TAA intoxicated groups increased significantly after 24 h, (+9.31%), 48 h (+7.11%) & 72 h (+5.39%). Ginseng alone has insignificant decreased on serum glucose. Mean while ginseng pretreatment in TAA intoxicated rats improved serum glucose at different intervals 24, 48 and 72 hours.

Serum and liver enzyme AST, ALT, γ-GT and ALP activities were estimated as markers of liver function (Table 1 & 2). TAA intoxicated rats showed high significant increases in these enzymes activities after 24, 48 and 72 hours. Ginseng pretreatment slightly improved the dangerous effect of TAA on the activities of the studied enzymes. Ginseng alone slightly decreased the activities of serum AST, ALT, ALP and γ-GT (Tables 1 & 2) when compared with control (Tables 1 & 2).

GSH in TAA intoxicated groups in (Table 3) slightly decreased at 24 h (-63.02%) 48 h (-56.77%) and 72 h (-48.59%). GSHR activity reduced significantly at 24 h, 48 and 72 h (-10.69, -40.77 & -42.98%) respectively. On the otherhand LPO was stimulated by TAA intoxication and increased significantly after 24, 48 and 72 h ( +23.01 %, +21.40 % & 20.70%) respectively.

Ginseng pretreatment in TAA intoxicated rats enhanced the liver contents of GSH & LPO as well as the activities of GSH-R (Table 3).

Ginseng alone has no effect on both GSH & LPO and GSH-R activity when compared with control group (Table 3).
Table (1): Serum glucose (mg/100 ml), AST, AIT, AIP and γ-GT (u/L) activities in control (C), ginseng (G) and thioacetamide (TA) at different time intervals (24, 48 and 72 hrs)

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>G</th>
<th>TA 24</th>
<th>G + TA 24</th>
<th>TA 48</th>
<th>G + TA 48</th>
<th>TA 72</th>
<th>G + TA 72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose (mg/100ml)</td>
<td>93.42±2.22</td>
<td>92.20±2.33</td>
<td>102.12±2.75*</td>
<td>97.12±2.64</td>
<td>100.07±2.50*</td>
<td>95.97±3.29</td>
<td>96.46±2.61</td>
<td>94.01±3.29</td>
</tr>
<tr>
<td>% of change</td>
<td>-1.30</td>
<td>+9.31</td>
<td>+3.96</td>
<td>+7.11</td>
<td>+2.73</td>
<td>+5.39</td>
<td>+0.63</td>
<td></td>
</tr>
<tr>
<td>Serum AST (u/L)</td>
<td>13.40±0.68</td>
<td>13.40±1.39</td>
<td>22.20±1.04*</td>
<td>15.20±0.92</td>
<td>17.60±0.68</td>
<td>15.00±0.84</td>
<td>16.61±1.12</td>
<td>14.60±0.73</td>
</tr>
<tr>
<td>% of change</td>
<td>-1.47</td>
<td>+63.23</td>
<td>+11.76</td>
<td>+29.41</td>
<td>+10.29</td>
<td>+22.13</td>
<td>+8.62</td>
<td></td>
</tr>
<tr>
<td>Serum AIT (u/L)</td>
<td>14.80±0.81</td>
<td>14.04±1.17</td>
<td>23.60±1.43</td>
<td>19.41±1.03</td>
<td>20.61±0.20</td>
<td>18.20±0.58</td>
<td>19.01±0.75</td>
<td>16.00±0.63</td>
</tr>
<tr>
<td>% of change</td>
<td>-5.13</td>
<td>+59.45</td>
<td>+31.14</td>
<td>+39.25</td>
<td>+22.97</td>
<td>+28.44</td>
<td>+8.11</td>
<td></td>
</tr>
<tr>
<td>Serum AIP (u/L)</td>
<td>54.22±2.58</td>
<td>54.10±5.13</td>
<td>72.66±3.60</td>
<td>69.06±2.55</td>
<td>70.04±4.47</td>
<td>62.71±1.73</td>
<td>67.91±4.33</td>
<td>58.10±2.59</td>
</tr>
<tr>
<td>% of change</td>
<td>-0.22</td>
<td>+34.01</td>
<td>+27.36</td>
<td>+31.02</td>
<td>+15.65</td>
<td>+25.24</td>
<td>+7.15</td>
<td></td>
</tr>
<tr>
<td>Serum γ-GT (u/L)</td>
<td>1.38±0.29</td>
<td>1.27±0.30</td>
<td>3.38±0.36</td>
<td>2.6±0.38</td>
<td>3.96±0.37</td>
<td>3.28±0.43</td>
<td>2.94±0.37</td>
<td>2.48±0.31</td>
</tr>
<tr>
<td>% of change</td>
<td>-7.97</td>
<td>+144.92</td>
<td>+88.41</td>
<td>+137.68</td>
<td>+113.04</td>
<td>+79.71</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All values represent the mean ±SE of 6 animals.
* Significant at P<0.05

Table (2): Liver fresh tissue AST, AIT and AIP (u/100 g) activities in control (C), ginseng (G) and thioacetamide (TA) at different time intervals (24, 48 & 72 hrs).

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>G</th>
<th>TA 24</th>
<th>G + TA 24</th>
<th>TA 48</th>
<th>G + TA 48</th>
<th>TA 72</th>
<th>G + TA 72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver AST u/100g</td>
<td>14.74±1.34</td>
<td>14.21±1.16</td>
<td>41.60±2.22*</td>
<td>36.40±1.78</td>
<td>37.90±4.78*</td>
<td>29.90±2.69</td>
<td>30.24±3.51</td>
<td>19.98±1.21</td>
</tr>
<tr>
<td>% of change</td>
<td>-3.59</td>
<td>+182.22</td>
<td>+146.94</td>
<td>+157.12</td>
<td>+102.84</td>
<td>+105.15</td>
<td>+35.54</td>
<td></td>
</tr>
<tr>
<td>Liver AIT u/100g</td>
<td>502.10±33.72</td>
<td>497.02±48.88</td>
<td>671.67±33.29</td>
<td>586.71±24.95</td>
<td>660.98±42.60</td>
<td>579.38±49.23</td>
<td>646.98±49.95</td>
<td>558.14±10.70</td>
</tr>
<tr>
<td>% of change</td>
<td>-1.01</td>
<td>+33.77</td>
<td>+18.84</td>
<td>+31.64</td>
<td>+15.39</td>
<td>+28.85</td>
<td>+11.16</td>
<td></td>
</tr>
<tr>
<td>Liver AIP u/100g</td>
<td>299.08±41.59</td>
<td>291.14±38.41*</td>
<td>374.26±72.89</td>
<td>343.40±21.86</td>
<td>352.90±10.26</td>
<td>337.78±27.24</td>
<td>329.21±18.13</td>
<td></td>
</tr>
<tr>
<td>% of change</td>
<td>-2.66</td>
<td>+30.41</td>
<td>+25.13</td>
<td>+14.81</td>
<td>+17.99</td>
<td>+12.93</td>
<td>+10.07</td>
<td></td>
</tr>
</tbody>
</table>

All values represent the mean ± SE of 6 animals.
* Significant at P<0.05
Table (3): Liver glutathion (GSH) mg/g wet. Tissue, glutathion reductase (GSSGR) mg/g wet. Tissue and lipid peroxidation (LPO) /n mol/g wet. Tissue in control (C), ginseng (G) and thioacetamide (TA) at different time intervals (24, 48 & 72 hrs)

<table>
<thead>
<tr>
<th></th>
<th>C</th>
<th>G</th>
<th>TA 24</th>
<th>G + TA 24</th>
<th>TA 48</th>
<th>G + TA 48</th>
<th>TA 72</th>
<th>G + TA 72</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSH</td>
<td>3.84 ±0.32</td>
<td>3.71±0.15</td>
<td>1.42</td>
<td>2.01</td>
<td>1.66</td>
<td>2.79</td>
<td>1.96</td>
<td>2.93</td>
</tr>
<tr>
<td></td>
<td>- 3.39</td>
<td>- 63.02</td>
<td>-47.65</td>
<td>-56.77</td>
<td>-27.34</td>
<td>-48.59</td>
<td>-23.69</td>
<td></td>
</tr>
<tr>
<td>% of change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GSHR</td>
<td>10390.24±180</td>
<td>10386.90±250.32</td>
<td>9279.90±367.35</td>
<td>9431.50±296.87</td>
<td>6153.83±641.08</td>
<td>9621.17±600.81</td>
<td>5923.50±722.99</td>
<td>10292.17±560.05</td>
</tr>
<tr>
<td>% of change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPO</td>
<td>9.95±0.50</td>
<td>9.81±0.49</td>
<td>12.24</td>
<td>11.02</td>
<td>12.08</td>
<td>10.72</td>
<td>12.01</td>
<td>10.36</td>
</tr>
<tr>
<td>% of change</td>
<td></td>
<td></td>
<td>+23.01</td>
<td>+10.75</td>
<td>+21.40</td>
<td>+7.73</td>
<td>+20.70</td>
<td>+4.12</td>
</tr>
</tbody>
</table>

-All values represent the mean ± SE of 6 animals.

**Discussion**

The toxic effects of TAA may generally attributed to its selective nuclear oxidative damage (Clawson et al., 1997), decreases in total liver protein and liver microsomal protein (Cascales et al., 1991), as well as decreases in serum albumin concentration. The administration of thioacetamide in rats induces nodular cirrhosis of the liver, characterized by fibrous septae, parenchymal nodules, proliferation of the bile ducts and changes in lipid metabolism (Torres et al., 1997).

The formation of free radicals and cytotoxic oxygen metabolites probably play a key role in various types of tissue degeneration and pathology such as aging, cancer and retinal degeneration (Brown, 1995). In order to overcome the effect of free radicals and to reduce the damaging effect of oxidants, a variety of pharmacological antioxidants such as - glutathione, celluloplasmin and transferrin have examined (Gutteridge, 1986). In our study, we attempt to investigate the effect of Panax ginseng (ginseng) root to modulate the hepatotoxic effect induced by thioacetamide in adult male albino rats.

TAA-toxicity led to an elevation of serum glucose after 24 h. Followed by significant reduction after 48 h. and begin to return towards the normal level after 72 h. This effect may be attributed to transient effect of TAA on liver glycogen producing glycogenolysis at first. The increased glucose also, may effect pancreatic B-cell and insulin secretion, which followed by enhancement effect after 72 h. Similar results were obtained by other drugs such acetomenophane. Two hours following a hepatotoxic dose, hepatic glycogen was depleted and this was accompanied by a marked increase in serum glucose (Hinson et al., 1983). Subsequently dramatic increase, in serum insulin were observed. Serum glucose levels showed an inverse correlation to serum insulin levels followed by decreased serum glucose levels (Hinson et al., 1984).

Treatment with ginseng prior to TAA administration produced prophylactic effect against TAA toxicity on liver and pancreas and could counteract the fluctuations of serum glucose level. Different mechanisms may be involved in lowering blood level by ginseng in TAA intoxicated rats after 24 h., Saponin content in ginseng could stimulate glucose uptake by erythrocytes (Hasegawa et al., 1994). Ginseng contains insulin-like substances which inhibited epinephrine-
induced lipolysis and stimulated lipogenesis from glucose in fat cells (Takaku et al., 1990). Finally ginseng inhibited absorption of glucose or maltose in small intestine and increased duodenal muscle movement (Onomura et al., 1999).

Regarding liver enzymes, transaminase activities were measured since they are indicators of liver damage, and γ-GT increased in drug liver toxicity. Acute liver diseases manely increased serum transaminases. The elevations of the activities of the studies enzymes were attributed to damage effect of TAA on liver tissue.

The administration of TAA in rats induced liver injury characterized by significant elevations of the activities of enzymes AST, ALT, AIP and γ-GT. These results are in agreement with (Osada et al., 1986, 1988) and Zimmermann et al., (1986 and 1987). They observed on increases in both serum transaminases 72 h. after TAA administration in rats. Nozu et al. (1992) detected increase γ-GT in rats treated with TAA administration in drinking water for 3 months. The results were obtained by (Cascales et al., 1991, Kretzschmar et al., 1991, Fontana, 1996 and Fontana et al., 1996) recorded significant increases of AIP and γ-GT activities in the serum of TAA treated rats suggesting an altered glutathione synthesis and export.

Improved enzyme activities (AST, ALT, AIP and γ-GT) in TAA-intoxicated rats pre-treated with ginseng may be due to the antioxidant activity of ginseng. These results are confirmed by the results of Zuin et al. (1987) who found that ginseng reduced γ-glutamyl transpeptidase levels in elderly patients after 6 and 12 weeks of treatments while transaminases were slightly, but not significantly lower after ginseng treatment for 6 and 12 weeks. Also, Hinko et al. (1985) found that hepatocytes exposed in vitro to an extract of ginsenosides from the roots of Panax ginseng, had an anti-hepatotoxic effect.

Glutathione (GSH) is central to the antioxidant defense system of the cell by reducing hydrogen peroxide (Meister, 1992). Although GSH decreased insignificantly in rats intoxicated with TAA, this decrease may be due to the inhibition of glutathione reductase (GSH-R) activity. GSHR is responsible for the reduction of oxidized glutathione (GSSG) to reduced glutathione (GSH). GSH-R posses a critical sulphhydryl group at its active site which participates in the reduction of GSSG (Gerson and Shaikh, 1984).

The present results indicated that pretreatment with ginseng improved the liver contents of GSH and the activities of GSH-R in TAA intoxicated rats at different tested intervals. The increased activity of GSH-R is required to maintain sufficient content of GSH which exerts on antioxidant property and lowers free radicals damaging effect (Whanger, 1992). The protective effect of Panax ginseng root has been examined in human (Yun and Choi, 1998 and Lee et al., 2002), rat (Xiaoguang et al., 1998 and Nehal and Amira 2002) and mice (Yun et al., 1996). They all deduced that Panax ginseng root has a potent therapeutic activity and could enhance immune function.

In addition to the reduction of liver GSH content and activity of GSH-R, there was also an increase of liver lipid peroxidation in TAA-intoxicated rats after 24, 48 and 72 h. when compared with control group. These results indicated that GSH depletion and LPO elevation (oxidative stress) could play an indirect role in the hepatotoxicity of TAA. This evidence is supported by Dyroff and Neal (1981) who reported that reactive intermediates by TAA (thioacetamide sulfoxide and sulfone) are involved in the initiation of liver injury.

The present data showed that ginseng had a protective effect against TAA toxicity. The possible mechanisms would be firstly: the antioxidative properties of its ginsenoside compounds, since the effect of ginseng as an antioxidant agent are well known and its effect as a protective agent against lipid peroxidation in the liver and brain have been reported (Lee et al., 1995 and Xiaoguang et al.,1998). Zhang et al. (1996) detected the stabilization of lipid structures against attack by free radicals as a result of ginseng intake. Likewise, it has been shown that the saponins contained in ginseng cause transcriotion of the superoxide dismutase gene (Cu-Zn-SOD) mediated by the transcription
factor AP2 (Kim et al., 1996). Additionally, it has been reported that ginseng administration could increase the hepatic glutathione peroxidase activity and could reduce glutathione level in liver (Voces et al., 1999). Superoxide dismutase and glutathione peroxidase are the most important antioxidant enzymes in the antioxidant defense system. The second mechanism involves: a) Stimulating effect on DNA repair synthesis (Rhee et al., 1990), b) Inhibitory effect on mutagenicity (Rhee et al., 1990), c) stimulating effect on protein and RNA synthesis (Yokozawa et al., 1996), d) stimulating effect on cell-immune system (Shin et al., 2000). Also, Bae and Lee (2004) suggested that the inhibitory effect of ginseng on the formation of glycated hemoglobin could be attributed to the antioxidative activity of ginseng.

From our present data it can be concluded that alteration of liver function and oxidation status by TAA intoxication could be improved in rats pretreated with ginseng.

References:


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مقدرة الجينسج المضادة للتسمم الكبدي المحدث بالثيوأسينتاميد في الجرذان البيضاء

1- أميرة تهامي إبراهيم ، أحكام الجندي، 2- بشرى الظواهرى.
1- قسم علم الحيوان - كلية العلوم جامعة الأزهر للبنات، 2- قسم فسيولوجى- كلية طب جامعة الأزهر للبنات.

يعتبر مركب الثيوأسينتاميد من المركيبات السامة والضارة جداً للصحة وخصوصا الإنسان. ولذلك فقد أدى إعطاء جرعة مقدارها 50 ميغجرام/ كيلوجرام من وزن الجسم للجرذان إلى زيادة ملحوظة في أنزيمات الكبد وأنجسحة كلها وخاصة عند 48 و 72 ساعة من إعطاء الثيوأسينتاميد وأيضاً أدى إلى زيادة واضحة وملحوظة في أنزيمات الكبد المضادة للأكسدة مثل أنزيم الجلوتاثيون ريداكتيز (GSSG-R) بينما ظل في معدلة الطبيعي أنزيم الجلوتاثيون المختزل (GSH) بينما زادت نسبة الدهون الفوقية في Lipid preoxidation أنسجة الكبد زيادة ملحوظة.

وقد سببت جذور نباتات الجينسج انخفاضاً لآثار الثيوأسينتاميد وكان لا عطاءه بجرعة مقدارها 117 ميغجرام/كيلوجرام من وزن الجسم يومياً ولمدة 10 أيام قبل إعطاء الثيوأسينتاميد أنثراً واقعاً ضد هذه السمية.