Effect of Some Fruits and Vegetables Peels Extract on CCl4 Induced Hepatic Injury in Rats

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Abstract

Free radicals generated by hepatotoxins like CCl4 may overpower the mechanism of the liver and cause hepatic damage. Though the modern medicinal system has grown phenomenally, the drug for treating hepatic disease is still a dream. Hence, people are looking at traditional systems of medicines for remedies to hepatic disorders. Phenolic compounds can act as antioxidants by many potential pathways such as free radical-scavenging, oxygen radical absorbance, and chelating of metal ions.

Aim: The present study was performed to evaluate antioxidants compounds of some fruit and vegetable peels extract (red apple, banana, red beet roots, and potatoes) and its effects on CCl4 induced hepatic injury in rats.

Methods: Extraction yield of phenolic compounds by different solvents (methanol, ethanol and diethyl ether), estimation of total phenolics, total flavonoids and total flavonols of red apple peels, banana peels, red beet peels and potato peels were estimated. A total of thirty six male healthy rats, weighing between (200-220gm) were divided into six groups. To induction cirrhosis all rats except control negative were subcutaneous injected by carbon tetrachloride CCl4 which diluted by paraffin oil (1:1) [in a dose of 2ml/kg of body weight of rat], twice in the week during the experimental feeding period, each group containing 6 rats. Control groups (1,2) negative and positive were fed on basal diet without supplementation. All treated cirrhotic groups (3-6) were fed on basal diet and administrated by gastric tube 2g/kg/day different methanol extract of some fruits and vegetables peels (apple APME, banana BPME, red beet RBME and potato PPME) had significant decrease in serum liver and kidney function parameters AST, ALT, uric acid, urea and creatinine) comparing with control positive. Also, it could be observed that all cirrhotic groups administrated with different methanol extract of some fruits and vegetables peels (apple APME, banana BPME, red beet RBME and potato PPME) had significant decrease in serum liver and kidney function parameters and protective effect against histopathological hepatotoxicity induced by CCl4 comparing with control positive. The best treatment was apple peels methanol extract APME which had lowest value of liver and kidney function parameters followed by red beet peels methanol extract RBME.

Conclusion: It can be concluded that extract of some fruits and vegetables peels (apple APME, banana BPME, red beet RBME and potato PPME) especially methanol extract has a significant protective effect against acute hepatotoxicity induced by CCl4 in rats, which may be due to its free radical scavenging effect and its ability to increase antioxidant activity.

Key Words: Peels – Cirrhosis – CCl4 – Antioxidants – Polyphenols.

Introduction

REACTIVE oxygen species (ROS) are constantly generated in vivo for physiological purposes. Their productions are often balanced by antioxidant defense system. However, excess ROS production beyond the ability of antioxidant defense system can cause oxidative damage to protein, lipid and nucleic acid [1]. Antioxidant defense include antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx), in addition to low molecular agents and dietary antioxidants. Disturbing of oxidant-antioxidant balance system is involved in development of many chronic diseases [2].

Liver, largest organ in the body is being evolved to maintain the body’s internal milieu and also protect itself from the challenges it faces during its functioning. Since it is involved in the biochemical conversions of various endogenous and exogenously administered substances, there is a possibility of generating various highly reactive species of free radicals. In spite of this free radicals generated by hepatotoxins like CCl4 may overpower...
the protective mechanism of the liver and cause hepatic damage. Though the modern medicinal system has grown phenomenally, the drug for treating hepatic disease is still a dream. Hence, people are looking at traditional systems of medicines for remedies to hepatic disorders [3].

Human diet has been for long known as a rich source of structurally diversified active chemicals, mainly antioxidants, e.g., vitamins and their precursors, polyphenols, and stilbenes that are bioavailable from edible fruits and vegetables. Red beetroot (Beta Vulgaris L.) is a vegetable characteristic of the Eastern and Central European diet, and is also used as a popular folk remedy for liver and kidney diseases, for stimulation of the immune and hematopoietic systems, and as a special diet in the treatment of cancer. Besides other active chemicals, beetroots contain a unique class of water-soluble, nonphenolic antioxidants, the betalains, including two classes of compounds, red betacyanins (principally betanin) and yellow betaxanthines [5,36].

Phenolic compounds can act as antioxidants by many potential pathways such as free radical-scavenging, oxygen radical absorbance, and chelating of metal ions [6]. The content of phenolic compound in apples is very high. Chlorogenic acid was the main polyphenols in all analysed apples [7]. Apple peels are very rich source of antioxidant and had significantly higher amounts of phenolic compound, antioxidant activity and antiproliferative activity than the flesh of apples [8,9].

Bananas are one of the most popular fruits in the world market. It is well known that, it contains various antioxidants, such as vitamin C, vitamin E, and β-carotene. Antioxidant capacity of a fruit may be due to other antioxidants, such as flavonoids. The antioxidant activity of the banana peel extract, against lipid autoxidation, was stronger than that of the banana pulp extract. This result was consistent with the gallicatehin analysis. The higher gallicatehin content may account for the better antioxidant effects. Thus, the antioxidant capacity of the bananas may be attributed to their gallicatehin content. Banana peel extract corresponded contain of gallicatehin, catechin, and epicatechin [10,11].

Beet root extracts, especially peel extracts, have shown relatively strong antioxidant activity with comparison to other vegetables [12-14]. Betanin the main beta-cyanine present in red beet root was found to be distributed mostly towards the outer parts of root, decreasing in the order peel, crown and flesh [15]. Also tyttie, et al., [16] found that both betanin and isobetanin were found in greater amounts in the peels than in the flesh of beet.

Phenolic acids in potatoes, vegetables and some of their products studied by authors’ [17], they found that chlorogenic derivatives were the most dominant soluble phenolic acid aglycon in the potatoes.

The present study was performed to evaluate antioxidants compounds of some fruit and vegetable peels extract (red apple, banana, red beet roots, and potatoes) and its effects on CCl4 induced hepatic injury in rats.

**Material and Methods**

Fruits and Vegetables (red apple, banana, red beet roots and potatoes) were obtained from local market Cairo, Egypt. The vegetables washed, hand peeled, and the peels cut into small slices and stored at –20°C, dried in freeze dryer until lyophilisation. Lyophilised samples are ground into fine powder with mortar and pestle.

**Extraction of phenolic compounds:**

The total phenolic compounds (TP) of apple, banana, potato and red beet root peels were extracted using six separate solvents (methanol, ethanol and diethyl ether) at solvent to samples ratio of 10: 1. Extraction was carried out using a shaking incubator at room temperature for 24h, followed by filtration through whatman No.1 filter paper. The residue was re-extracted in the same manner and the two filtrates were combined [18].

**Estimation of total phenolics:**

Total phenolic content of each extract was determined by the Folin-Ciocalteu micro-method (Slinkard and Singleton) [19]. Briefly, 20 µl of extract solution were mixed with 1.16ml distilled water and 100 µl of Folin-Ciocalteu reagent, followed by addition of 300 µl of Na2CO3 solution (20%) after 1min. and before 8min. Subsequently, the mixture was incubated in a shaking incubator at 40°C for 30min. and its absorbance was measured at 760nm. The phenolic content was expressed as gallic acid equivalents using the following linear equation based on the calibration curve:

\[ A = 0.98C+9.925 \times 10^{-3} \quad R^2 = 0.9996, \]

where A is the absorbance and C is concentration as gallic acid equivalents (µg/g).

**Determination of total flavonoids:**

Total flavonoid contents were determined using the method of Ordon ez, et al. [20] of sample solution. A volume of 0.5ml of 2% AlCl3 in ethanol
solution was added to 0.5ml of methanolic extract. After one hour at room temperature, the absorbance was measured at 420nm. A yellow color indicated the presence of flavonoids. Extract samples were evaluated at a final concentration of 0.1mg/ml. Total flavonols content were calculated as quercetin (mg/g) using the following equation based on the calibration curve: $y = 0.0255x$, $R^2 = 0.9812$, where $x$ was the absorbance and $y$ was the quercetin equivalent (mg/g).

**Determination of total flavonols:**

Total flavonols in the extracts were estimated using the method of Kumaran and Karunakaran, [21]. To 2.0ml of methanolic extract sample, 2.0ml of 2% AlCl$_3$ in ethanol and 3.0ml (50g/L) sodium acetate solutions were added. The absorption at 440nm was read after 2.5h. at 20°C. Extract samples were evaluated at a final concentration of 0.1mg/ml. Total flavonoid content was calculated as quercetin (mg/g) using the following equation based on the calibration curve: $y = 0.0255x$, $R^2 = 0.9812$, where $x$ was the absorbance and $y$ was the quercetin equivalent (mg/g).

**Experimental animal design:**

A total of thirty six male healthy rats, weighing between (200-220gm) were divided into six groups. To induction cirrhosis all rats except control negative were subcutaneous injected by carbon tetrachloride CCl$_4$ (which obtained from El-Gomhorria Company, Cairo, Egypt) that diluted by paraffin oil (1: 1) [in a dose of 2ml/kg of body weight of rat], twice in the week during the experimental feeding period according to the method described by (Wilfried, et al., 1994) [4]. Each group containing 6 rats. Control groups (1,2) negative and positive were fed on basal diet without supplementation. All treated cirrhotic groups (3-6) were fed on basal diet and administrated by gastric tube 2g/kg/day methanol extract of (apple peels methanol extract (APME), banana peels methanol extract (BPME), red beet peels methanol extract (RBPME) and potato peels methanol extract (PPME) respectively.

**Preparation of diet:**

The basal diet consisted of protein (13%), fat (4%), salt mixture (3.5%), vitamin mixture (1%), choline (0.2%), cellulose (5%) and the remainder was starch [22].

**Blood sampling:**

At the end of experiment rats were starved for 12hr., then sacrificed under ether anesthesia. Blood samples were collected from the aortic vein into clean dry centrifuge tubes and were stored at room temperature for 15 minutes, put into a refrigerator for 2 hour, then centrifuged for 10 minutes at 3000 rpm to separate serum. Serum was carefully aspirated and transferred into dry clean Wasser-man tubes by using a Pasteur pipette and kept frozen at (–20c) till analysis.

**Analytical methods:**

Serum activities of aspartate amino transferase AST and alanine amino transferase ALT were measured according to the method described by Reitman and Frankel (1957) [23]. Serum urea nitrogen, uric acid, creatinine were determined according to the methods described by Patton and Crouch, (1977) [24], Fossati, et al. (1980) [25] and Husdan and Rapoport, (1968) [26] respectively.

**Histopathological examination:**

Specimens from the liver and kidneys were taken immediately after sacrificing the rats and immersed in 10% neutral buffered formalin. The fixed specimens were then trimmed, washed, and dehydrated in ascending grades of alcohol, then cleared in xylene, embedded in paraffin, sectioned at 4-6 micron thickness and stained with Hematoxy- ylen and Eosin (Carleton, 1979) [27] and examined microscopically.

**Statistical analysis:**

The obtained data were statistically analyzed according to SAS, 1996 [28].

**Results and Discussion**

Table (1) and Fig. (1), illustrates the yield of different organic solvents i.e. methanol, ethanol, and diethyl ether of apple, banana, red beet and potato peels. Results clearly showed that, extraction yield of extracts are strongly depended on the polarity of the organic solvents (Julkunen-Tiito, 1985 [29]; Marinova and Yanishlivea, 1997 [30]). Methanol extracts of tested sample proved that the best solvent for yield extraction of all tested solvents, followed by ethanol, acetone and diethyl ether. The maximum amount of yields for fruits and vegetables peels was obtained by methanol.

Table (2) and Fig. (2), shows total polyphenols content of different organic solvents i.e. methanol, ethanol and diethyl ether of apple, banana, red beet and potato peels. Results showed that varying of total polyphenols of all tested samples. The amount of polyphenols depends on the polarity of the organic solvents (Marinova and Yanishlivea, 1997 [30]). There were significant differences between all studied samples of total polyphenols ($p \leq 0.05$).
There was a strong positive correlation between yield extracts of tested samples and polyphenols content as shown in Table (1). These results were in agreement with those obtained by Bravo (1998) [31] and Pawel, et al. (2008) [32].

Total flavonoids and flavonols of methanol extracts of apple, banana, red beet and potato peels were illustrated in Table (3) and Fig. (3). Potato peels showed the highest significant percentage of flavonoids (1.29±0.03) followed by red beet, apple and banana peels respectively. Also, red beet peels recorded the highest significant value of flavonols (1.32±0.18) than the other peels.

The effect of methanol extract of some fruits and vegetables peels (apple APME, banana BPME, red beet RBPME and potato PPME) on food intake, body weight gain, food efficiency ratio, liver function parameters (AST and ALT), kidney function parameters (urea, uric acid and creatinine) and histopathological examination of liver and kidney in cirrhotic rats induced by Ccl4 were showed in Tables (4,5) and Photos (1-12).

Data in Table (4), it could be observed that cirrhotic rats (control positive group) had significant decrease in body weight gain (BWG) and food efficiency ratio (FER) comparing with control negative group. Also, it could be observed that all cirrhotic groups administrated with different methanol extract of some fruits and vegetables peels (apple APME, banana BPME, red beet RBPME and potato PPME) had significant increase in body weight gain (BWG) and food efficiency ratio (FER), while there are no significant differences in food intake comparing with control positive. This results was agreement with previous studies [33,34,37].

Data in Table (5), it could be observed that cirrhotic rats (control positive group) had significant increase in serum liver function and kidney function parameters (AST, ALT, uric acid, urea, and creatinine) comparing with control negative group. Also, it could be observed that all cirrhotic groups administrated with different methanol extract of some fruits and vegetables peels (apple APME, banana BPME, red beet RBPME and potato PPME) had significant decrease in serum liver function parameters (aspartate amino transferase AST and alanine amino transferase ALT) and serum kidney function parameters (uric acid, urea and creatinine) comparing with control positive. The best treatment was apple peels methanol extract APME which had lowest value of liver and kidney function parameters followed by red beet peels methanol extract RBME. This results was agreement with previous authors [33,34] who reported that apple polyphenols AP significantly prevented the increase in serum ALT and AST levels in acute liver injury induced by CCl4 and produced a marked amelioration in the histopathological hepatic lesions coupled to weight loss. Also its results indicate that AP has a significant protective effect against acute hepatotoxicity induced by CCl4 in mice, which may be due to its free radical scavenging effect, inhibition of lipid peroxidation, and its ability to increase antioxidant activity. And also this results was agreement with previous studies which, it could be concluded that pretreatment with beetroot juice can counteract, to some extent, xenobiotic-induced oxidative stress in rats [35]. Researchers [36] found a class of dietary cationized antioxidants (betalains) in red beets (Beta vulgaris L.) This class of antioxidants consists mainly of betanin (betanidin 5-O-beta-glucoside). Betanin was found to inhibit lipid peroxidation and heme decomposition. They believe that red beet products used regularly in the diet may provide benefits against certain oxidative stress-related disorders.

Histopathological examination:

Liver: Microscopicall examination of liver of rat in negative control group, showing the normal histological structure Photo (1). While microscopicall examination of liver of cirrhotic rats which fed on basal diet with Subcutaneous injection by CCl4 (control positive) showing more sever and prolonged degeneration alteration, swelling of hepatocytes Photo (3). In addition, microscopicall examination of liver of cirrhotic rats which fed on basal diet with Subcutaneous injection by Ccl4 and administrated with apple peels methanol extract APME or red beet peels methanol extract RBME (2g/Kg/day) showing only apparent normal histological structure and/or slight alteration in hepatocytes Photos (5,9). Moreover, microscopicall examination of liver of cirrhotic rats which fed on basal diet with Subcutaneous injection by CCl4 and administrated with banana peels methanol extract BPME or potato peels methanol extract PPME (2g/Kg/day) showing only a mild Degeneration alteration and/or mild swelling of hepatocytes Photos (7,11). This results were agreement with previous studies [33,34,37].
Kidney: Microscopicall examination of kidney of cirrhotic rats which fed on basal diet with Subcutaneous injection by CCl4 (control positive) showing a focal tubular necrosis associated with mononuclear cells infiltration Photo (4). While Microscopicall examination of kidney of rat in negative control group, and microscopicall examination of kidney of cirrhotic rat which fed on basal diet with Subcutaneous injection by CCl4 and administrated with red beet peels methanol extract RBPME (2g/Kg/day) showing the normal histological structure Photos (2,10). Moreover, Microscopicall examination of kidney of cirrhotic rats which fed on basal diet with Subcutaneous injection by CCl4 and administrated with apple peels methanol extract APME (2g/Kg/day) showing activation of Kupffer cells Photo (6). Microscopicall examination of kidney of cirrhotic rats which fed on basal diet with Subcutaneous injection by CCl4 and administrated with banana peels methanol extract BPME (2g/Kg/day) showing mild histological alteration Photo (8). This results were agreement with previous studies [33,34,37].

**Conclusion:** It can be concluded that extract of some fruits and vegetables peels (apple APME, banana BPME, red beet RBPME and potato PPME) especially methanol extract has a significant protective effect against acute hepatotoxicity induced by CCl4 in rats, which may be due to its free radical scavenging effect and its ability to increase antioxidant activity.

### Table (1): Yield of different organic solvents extracts of apple, banana, red beet and potato peels.

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Apple peels (mg/g)</th>
<th>Banana peels (mg/g)</th>
<th>Red beet peels (mg/g)</th>
<th>Potato peels (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol</td>
<td>130.00±2.76</td>
<td>110.20±3.00</td>
<td>140.50±2.77</td>
<td>148.80±5.67</td>
</tr>
<tr>
<td>Ethanol</td>
<td>120.00±3.44</td>
<td>110.10±3.66</td>
<td>110.80±2.70</td>
<td>120.23±7.80</td>
</tr>
<tr>
<td>Diethyl ether</td>
<td>80.40±3.70</td>
<td>80.50±4.50</td>
<td>100.10±3.65</td>
<td>100.57±11.90</td>
</tr>
</tbody>
</table>

Results calculated as mg/g dry weight basis.

### Table (2): Polyphenols contents of different organic solvents extracts of apple, banana, red beet and potato peels.

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Apple peels (mg/g)</th>
<th>Banana peels (mg/g)</th>
<th>Red beet peels (mg/g)</th>
<th>Potato peels (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methanol</td>
<td>25.7±1.5</td>
<td>22.8±1.1</td>
<td>15.1±0.8</td>
<td>16.3±0.9</td>
</tr>
<tr>
<td>Ethanol</td>
<td>18.5±2.0</td>
<td>16.6±0.6</td>
<td>13.3±0.4</td>
<td>14.3±0.6</td>
</tr>
<tr>
<td>Diethyl ether</td>
<td>11.3±0.7</td>
<td>11.6±0.6</td>
<td>11.7±0.5</td>
<td>11.6±0.4</td>
</tr>
</tbody>
</table>

Results calculated as mg/g dry weight basis.

### Table (3): Total flavonoids and flavonols of methanol extracts of apple, banana, red beet and potato peels.

<table>
<thead>
<tr>
<th>Material</th>
<th>Apple peels (mg/g)</th>
<th>Banana peels (mg/g)</th>
<th>Red beet peels (mg/g)</th>
<th>Potato peels (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavonoids</td>
<td>1.03±0.01</td>
<td>0.84±0.01</td>
<td>1.17±0.06</td>
<td>1.29±0.03</td>
</tr>
<tr>
<td>Flavonols</td>
<td>1.06±0.03</td>
<td>0.83±0.01</td>
<td>1.32±0.18</td>
<td>1.21±0.02</td>
</tr>
</tbody>
</table>

Results calculated as mg/g dry weight basis.

### Table (4): Effect of some fruits and vegetables peels extract on food intake, BWG% and FER (mean ± SE).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Food intake g/day</th>
<th>BWG %</th>
<th>FER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative control</td>
<td>11.9</td>
<td>55.33±3.42b</td>
<td>0.22±0.007b</td>
</tr>
<tr>
<td>Positive control</td>
<td>10.9</td>
<td>34.18±2.95c</td>
<td>0.16±0.01c</td>
</tr>
<tr>
<td>APME</td>
<td>12.8</td>
<td>65.18±3.78a</td>
<td>0.26±0.012a</td>
</tr>
<tr>
<td>BPME</td>
<td>11.5</td>
<td>58.91±2.63b</td>
<td>0.23±0.008b</td>
</tr>
<tr>
<td>RBPME</td>
<td>12.2</td>
<td>63.49±2.86a</td>
<td>0.25±0.007a</td>
</tr>
<tr>
<td>PPME</td>
<td>11.8</td>
<td>55.49±2.86b</td>
<td>0.21±0.009b</td>
</tr>
</tbody>
</table>

* Values with the same letters indicate non-significant difference (p>0.05) and vice versa.
BWG%: Body weight gain ratio.
FER: Food efficiency ratio.
Table (5): Effect of some fruits and vegetables peels extract on serum liver function AST and ALT and kidney function Uric acid, Urea and Creatinine (mean ± SE).

<table>
<thead>
<tr>
<th>Groups</th>
<th>AST (U/L)</th>
<th>ALT (U/L)</th>
<th>Uric acid (mg/dl)</th>
<th>Urea Nitrogen (mg/dl)</th>
<th>Creatinine (mg/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative control</td>
<td>62.77±1.80c</td>
<td>29.45±0.99c</td>
<td>2.02±0.12b</td>
<td>21.66±0.84d</td>
<td>0.58±0.02c</td>
</tr>
<tr>
<td>Positive control</td>
<td>97.92±1.34a</td>
<td>65.55±1.01a</td>
<td>2.254±0.05a</td>
<td>48.56±1.60a</td>
<td>1.04±0.02a</td>
</tr>
<tr>
<td>APME</td>
<td>65.88±1.61c</td>
<td>32.54±1.53c</td>
<td>1.95±0.06b</td>
<td>23.53±0.67cd</td>
<td>0.59±0.01c</td>
</tr>
<tr>
<td>BPME</td>
<td>71.68±1.43b</td>
<td>40.23±1.55b</td>
<td>1.97±0.05b</td>
<td>29.76±0.88b</td>
<td>0.67±0.02b</td>
</tr>
<tr>
<td>RBPME</td>
<td>68.33±1.27bc</td>
<td>35.99±1.23b</td>
<td>1.77±0.06b</td>
<td>26.88±0.47c</td>
<td>0.61±0.01c</td>
</tr>
<tr>
<td>PPME</td>
<td>75.88±1.61b</td>
<td>37.54±1.53b</td>
<td>1.99±0.06b</td>
<td>30.53±0.67b</td>
<td>0.77±0.01b</td>
</tr>
</tbody>
</table>

* Values with the same letters indicate non significant difference (p<0.05) and vice versa.

Fig. (1): The yield of different organic solvents extracts of apple, banana, red beet and potato peels.

Fig. (2): Polphenol contents of different organic solvents extracts of apple, banana, red beet and potato peels.

Fig. (3): Total flavonoids and flavonols of methanol extracts of apple, banana, red beet and potato peels.

Photo (1): Microscopical examination of liver of rat in negative control group, showing normal histological structure.

Photo (2): Microscopical examination of kidney of rat in negative control group, showing normal histological structure.
Photo (3): Microscopical examination of liver of rats fed on basal diet with subcutaneous injection by Ccl4 (control positive) showing more severe and prolonged degeneration alteration, swelling of hepatocytes.

Photo (4): Microscopical examination of kidney of rats fed on basal diet with subcutaneous injection by Ccl4 (control positive) showing focal tubular necrosis associated with mononuclear cells infiltration.

Photo (5): Microscopical examination of liver of rats fed on basal diet with subcutaneous injection by Ccl4 and administrated with APME (2g/Kg/day) showing only a slight alteration in hepatocytes.

Photo (6): Microscopical examination of kidney of rats fed on basal diet with subcutaneous injection by Ccl4 and administrated with APME (2g/Kg/day) showing activation of Kupffer cells.

Photo (7): Microscopical examination of liver of rats fed on basal diet with subcutaneous injection by Ccl4 and administrated with BPME (2g/Kg/day) showing mild degeneration alteration and mild swelling of hepatocytes.

Photo (8): Microscopical examination of kidney of rats fed on basal diet with subcutaneous injection by Ccl4 and administrated with BPME (2g/Kg/day) showing mild histological alteration.
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Photo (9): Microscopical examination of liver of rat fed on basal diet with subcutaneous injection by Ccl4 and administrated with RBPME (2g/Kg/day), showing apparent normal histological structure.

Photo (10): Microscopical examination of kidney of rat fed on basal diet with subcutaneous injection by Ccl4 and administrated with RBPME (2g/Kg/day), showing normal histological structure.

Photo (11): Microscopical examination of liver of rats fed on basal diet with subcutaneous injection by Ccl4 and administrated with PPME (2g/Kg/day) showing mild Degeneration alteration.

Photo (12): Microscopical examination of kidney of rats fed on basal diet with subcutaneous injection by Ccl4 and administrated with PPME (2g/Kg/day) showing hypertrophy of glomerular tuft.

References


