The Therapeutic and Immunological Effect of Strawberry Extracts in Hepatic Rats

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ABSTRACT

This study aimed to determine the effect of different levels of strawberry extracts on biochemical and immunological changes of infected mice liver. The study used (20) white Albino rats and were divided into two main groups first set of mice infected with hepatitis Second Group of negative control, a non-mice group infected and was then the first and second main group is divided into five sub-groups, including three groups fed with different concentrations of strawberry extracts 5%, 10%, 15% and one group control positive infected with the disease do not feed on the experimental diet and another control negative non-infected this disease means that all mice are divided into five groups of four mice in each group. And then were injected with carbon tetrachloride mice twice a week for two weeks. the results the best treatments in the level of total cholesterol and triglycerides and LDL appeared in the experimental diet groups, 10% and 15% of strawberry extracts and also showed the immune results significantly different in each experimental diet groups when compared to the group negative control. Results recommended to hepatic patients to added strawberry extracts in their diet because it contains useful component.

Keywords: strawberry extracts - hepatitis- immunological change.

Classification: FOR Code: 070799

Language: English
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I. ABSTRACT

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Keywords: strawberry extracts - hepatitis - immunological change.

Author: Associate Prof. of Animal Physiology Dept of Biology, Faculty of Science, Al-Baha University.

II. INTRODUCTION

Strawberries have a common scientific name of Fragaria, and there are different suffixes for different varieties, such as Fragaria vesca for wild strawberry, and Fragaria orientalis for strawberries found in Siberia, among others. Strawberries grow in bushes and are delicious seasonal fruits that also boost your .(Manganaris et al., 2014). We know that fruits, particularly berries and those with exotic colors are rich in antioxidants, which means that they are huge boosters to your health. Strawberries are no exception to this rule; in addition to antioxidants and polyphenols. (Colquhoun., 2012). The immune system is our body’s first line of defense against infections, microbial action, and a variety of other potentially dangerous conditions. Vitamin C present in strawberry, the immune system and helping in curing common cough and cold. Vitamin C is also an antioxidant, which means that it neutralizes free radicals, the harmful byproducts of cellular metabolism that are constantly created in our body. These free radicals are responsible for mutating the DNA of healthy cells into cancerous cells and are subsequently responsible for a number of diseases, including heart disease and various cancers. A single serving of strawberries has approximately 150% of your daily requirement of vitamin C, isn’t that incredible. (Giampieri et al., 2012). Vitamin C and phytochemicals in strawberries, strawberries are rich in iodine as well, which is very helpful for regulating the proper functioning of the brain and nervous system. Potassium, which is found in significant quantities in strawberries, also has been linked to improved cognitive function by increasing the blood flow to the brain. Research studies on students have shown that when potassium levels of high concentration are consumed; memory and recall abilities seem to be strengthened in test-taking. There is a good
reason why bananas and strawberries are considered “brain food. (Parry et al., 2006). Grape (vitis uniferal) polyphenols are know to be beneficial ad free radical scavengers. Previous experiments demonstrated that molecules other than polyphenols, such as simple carbohdrate and organic acid, can acts as free radical in habitors. (Lipinska et al., 2014). The liver is the largest solid organ in the body. People may not know that the liver is also the largest gland in the body. The liver is actually two different types of gland. It is a secretory gland because it has a specialized structure that is designed to allow it to make and secrete bile into the bile ducts. It also is an endocrine gland since it makes and secretes chemicals directly into the blood that have effects on other organs in the body. Bile is a fluid that both aids in digestion and absorption of fats as well as carries waste products into the intestine. The liver weighs about three and a half pounds (1.6 kilograms). It measures on average, about 8 inches (20 cm) horizontally (across), and 6.5 inches (17 cm) vertically (down), and is 4.5 inches (12 cm) thick. (Maton et al.,1993).

III. AIM OF STUDY

The effect of strawberry extracts on biochemical changes (serum lipids – liver function – kidney function and immunological changes) in hepatic rats.

IV. MATERIALS AND METHODS

4.1 Materials

- The studied samples were (strawberry extracts), were obtained from local market, Cairo, Egypt.
- Casein, vitamins, salts and cholesterol powder and pure fine chemical carbone tetrachloride were pursed from El- Gomhoria company, Cairo, Egypt.
- Normal male albino rats were obtained from Research institute of Ophthalmology Medical Analysis Department, Giza, Egypt.

- Method

Preparation of plant

- Purched of strawberry fruits.
- Each 10kg of strawberry give 1 kg powder extract (we used 30 kg strawberry).
- Washed and cleaned the Strawberry fruits.
- Drying the Strawberry fruits in clean place under room temperature with good airing for 7 days.
- After dry Strawberry fruits without exposured to heat or sun ray.
- Stored in polyethylene bags. Far- of moisture or heat. And keep them until frish crushing and admixtures with experiment dite.

- Biological Experiment

- Animals

Twenty (20) adult male albino rats (Sprague Dawley strain) were used in the investigation. The animal were obtained from the veterining medicine institute, Cairo, Egypt. Each rats was housed in special cage under controlled condition every day. The animal were observed for external appearance, shape, color and distribution of hair and physical activity. All rats were fed one week on control diet before the beginning of the experiment for adaptation, the rats were weight tow is a week for 4 weeks. The diet was presented to rats in special covered cups to avoid food loss. All rats were provided with water by glass tubes through wire cage. The rats were fed a diet libitum through the period of experiment. The final weight was recorded for organs weight calculation. All the experiment occur in biological manufactory of faculty of home Economic, Monofia university.

- Experiment Design

Twenty (20) adult male albino rats Sprague Dawely Strain of an average (100 – 120g) and age (45 days) were used. Divided into two major groups (hepatits groups addition to negative control group) after that first group were divided into 4 sub groups (3 group treatment with 3 concentration 5%, 10%, 15%) of Strawberry extract and one group positive controls has the
diseased without treatment and Scand group are control negative. That means all rats divided into 5 groups 4 rats in each sub group and fed several diets for 4 weeks.

Preparation of hepatitis rats

Normal healthy adult male albino rats were injection by carbon tetra chloride twice weekly for two weeks, according to the method described by then investigated level of Got and Gpt by random select to any rat to obtained sample blood serum, after positivism form infect rats were divided into 5 sub groups 4 rats in each sub group.

First Main Group (16 rats)

Hepatites rats were divided into 4 subgroup according to the following scheme 4 rats in each subgroup.

<table>
<thead>
<tr>
<th>Subgroup 1</th>
<th>fed on basal diet only as the control positive.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgroup 2</td>
<td>fed on basal diet containing 5% Strawberry extract.</td>
</tr>
<tr>
<td>Subgroup 3</td>
<td>fed on basal diet containing 10% Strawberry extract.</td>
</tr>
<tr>
<td>Subgroup 4</td>
<td>fed on basal diet containing 15% Strawberry extract.</td>
</tr>
</tbody>
</table>

Scand Main Group (4 rats):

Healthy rats fed on basal diet as the control negative.

Samples collection

1) Blood

At the end of the for 4 weeks experiment period the animal were fasted for 12 h they incisions were made abdomen and blood sample were obtained from the portal vein into heparin zed centrifuge tubes. Plasma was separated by centrifugation at 4000 r. p. m for 10 minutes at room temperature them kept in plastic vial stored forzed until analysis.

2) Organs

The organs (liver, Kidney and Spleen) were excised, rinsed in chilled salin solution, then blotted on filter paper, and weighted separately to calculate absolute and relative organs weight.

Biochemical Analysis

2. Determination of triglycerides (Jacobs and Van Denmark, 1960).
5. Determination of plasma Albumin (Doumas and Biggs, 1971).

Statistical Analysis

Statistical analysis is carried out to (Snedecor and Cochran, 1967).

V. RESULTS AND DISCUSSION

1) Biological results

1.1 Effect of feeding different concentration (5%, 10%, 15%) of Strawberry extracts on biochemical changes on hepatitis albino rats

Table (1) show the effect of feeding different concentration of Strawberry extracts on serum
total cholesterol, triglyceride, LDL, and HDL in normal and hepatitis rats after 4 weeks of feeding.

**Total cholesterol** value in normal rats group was (162.54±12.23) mg/dl. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum total cholesterol values (166.25±10.35, 140.45±10.35, 155.30±45.30, and 160.20±10.35) mg/dl, respectively. Theses results showed that the best treatment was in the group obtained 15% Strawberry extracts.

**Serum triglyceride** value in normal rats group was (86.32±10.41) mg/dl. While in hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts were (81.20±8.45, 70.25±11.24, 72.45±6.25, and 85.48±4.18) mg/dl, for (positive control, 15%, 10%, and 5% Strawberry extracts), respectively. The best treatment was noticed in group of 15% Strawberry extracts.

**Serum LDL** value in normal rats group was (102.24±4.30) mg/dl. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum LDL values (109.15±8.15, 80.45±7.45, 88.35±6.20, and 91.25±4.30) mg/dl, respectively. Significant differences were observed in the group of 5%, 10% and 15% Strawberry extracts when compared with negative control.

**Serum HDL** in normal rats group was (72.65±0.02) mg/dl. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum HDL values (70.54±6.12, 86.15±3.68, 78.35±3.28, and 69.35±4.46) mg/dl, respectively. These results showed the best treatment in the group of 15% Strawberry extracts. These results are in agreement with those reported by Arpita Basu et al, (2009), who studied the effect of Freeze-dried strawberry powder improves lipid profile and lipid peroxidation in women with metabolic syndrome. They found that freeze-dried strawberry powder (FSP), a concentrated source of strawberry polyphenolic flavonoids, fiber, and phytosterols is a novel dietary fruit supplement marketed by selected fruit growers and special promotion groups. Not enough scientific data is available on the health benefits of this product. Our study shows the potential role of FSP in lowering total and LDL-cholesterol, and lipid peroxidation in women with metabolic syndrome, and suggests the need for larger controlled trials.

**Table (1):** Effect of feeding different concentration of Strawberry extracts on serum total cholesterol, triglyceride, LDL, and HDL on hepatitis albino rats

<table>
<thead>
<tr>
<th>Lipid Parameters</th>
<th>15% Strawberry extracts</th>
<th>10% Strawberry extracts</th>
<th>5% Strawberry extracts</th>
<th>Control (+)</th>
<th>Control(-)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total cholesterol (mg/dl)</strong></td>
<td>10.35±140.45</td>
<td>±45.30b ±155.30</td>
<td>0.35b*160.20±</td>
<td>±20.33b 166.25</td>
<td>162.54±12.23b</td>
</tr>
<tr>
<td><strong>Triglyceride (mg/dl)</strong></td>
<td>11.24±70.25</td>
<td>6.25b ±72.45</td>
<td>85.48±4.18°</td>
<td>±8.45° 81.20</td>
<td>10.41° ± 86.32</td>
</tr>
<tr>
<td><strong>LDL (mg/dl)</strong></td>
<td>80.45±7.45</td>
<td>88.35±6.20</td>
<td>4.30b 91.25±</td>
<td>±8.15° 109.15</td>
<td>4.30° 102.24±</td>
</tr>
<tr>
<td><strong>HDL (mg/dl)</strong></td>
<td>±3.68 86.15</td>
<td>±3.28 78.35</td>
<td>4.46b 69.35±</td>
<td>6.12b ± 70.54</td>
<td>0.02b 72.65±</td>
</tr>
</tbody>
</table>

Total Cholesterol (Best = <200 mg/dL, Borderline high = 200-239 mg/dL, High = 240 mg/dL or higher)Triglycerides (Best = <150 mg/dL, Borderline high = 150-199 mg/dL, High = 200-499 mg/dL, Very high = 500 mg/dL or higher)LDL Cholesterol (Best = ' <100 mg/dL,
Good = 100-129 mg/dL, Borderline high = 130-159 mg/dL, High = 160-189 mg/dL, Very high = 190 mg/dL or higher) HDL Cholesterol (Low = <40 mg/dL, Best = 60 mg/dL or higher) RGS ; Red Grap seed

Data presented in table (2) illustrated Effect of feeding different concentration (5%, 10%, 15%) of Strawberry extracts on liver function of hepatitis rats.

Aspartate amino transiminase (AST) value in the control (-) was (19.22±.15) U/l. While hepatitis rats groups: fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum AST values (225.25±15.15,105.35±9.45, 155.25±3.15, and 210.20±1.10) U/L, respectively. Significant differences were noticed between all groups of Strawberry extracts when compared with negative control.

Alanine amino transaminase (ALT) value in control (-) was (31.77±6.18) U/L. Hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum ALT values (305.46±27.31, 175.45±6.35, 225.25±4.15, and 278.45±4.45) U/L, respectively. Significant differences were observed between all groups of Strawberry extracts when compared with negative control.

Alkaline phosphate ALP value in control (-) group was (96.45±4.45) U/L. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum ALP values (245.5±35.20, 165.33±8.90, 205.20±8.25, and 230.05±7.25) U/L, respectively. The results proved significant differences between all groups of Strawberry extracts when compared with negative control.

Total Bilirubin TBIN value in control (-) group was (0.55±0.05) mg/dl. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum TBIN values (3.25±0.05, 2.45±0.02, 2.65±0.03, and 3.05±0.04) mg/dl, respectively. The results confirmed significant differences between all groups of Strawberry extracts when compared with negative control.

Albumin ALP values in control (-) group was (4.85±0.23) g/dl. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum TBIN values (1.06±0.11, 1.85±0.3, 1.25±0.04, and 1.05±0.20) g/dl, respectively. The results demonstrated significant differences between all groups of Strawberry extracts when compared with negative control.

Our result are in agreement with Sherifa et al., (2016) They aimed to evaluate the hepatoprotective effect of strawberry juice on experimentally induced liver injury in rats. To this end, rats were intraperitoneally injected with carbon tetrachloride (CCl4) with or without strawberry juice supplementation for 12 weeks and the hepatoprotective effect of strawberry was assessed by measuring serum liver enzyme markers, hepatic tissue redox status and apoptotic markers with various techniques including biochemistry, ELISA, quantitative PCR assays and histochemistry. The hepatoprotective effect of the strawberry was evident by preventing CCl4-induced increase in liver enzymes levels. Determination of oxidative balance showed that strawberry treatment significantly blunted CCl4-induced increase in oxidative stress markers and decrease in enzymatic and non-enzymatic molecules in hepatic tissue. Furthermore, strawberry supplementation enhanced the anti-apoptotic protein, Bcl-2, and restrained the pro-apoptotic proteins Bax and caspase-3 with a marked reduction in collagen areas in hepatic tissue. These findings demonstrated that strawberry (F. ananassa) juice possessed antioxidant, anti-apoptotic and anti-fibrotic properties, probably mediated by the presence of polyphenols and flavonoids compounds.
Table (2): Effect of feeding different concentration of Strawberry extracts on liver functions of rats with carbon tetra chloride induced hepatitis

<table>
<thead>
<tr>
<th>Liver Function</th>
<th>15% Strawberry extracts</th>
<th>10% Strawberry extracts</th>
<th>5% Strawberry extracts</th>
<th>Control (+)</th>
<th>Control(-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST (IU/L)</td>
<td>9.45±105.35±</td>
<td>3.15±155.25±</td>
<td>210.2±15.15d</td>
<td>225.25±15.15d</td>
<td>0.15±19.22±</td>
</tr>
<tr>
<td>ALT (IU/L)</td>
<td>175.45±6.35b</td>
<td>4.15±225.25±</td>
<td>278.45±4.45d</td>
<td>305.46±27.31d</td>
<td>31±6.18a</td>
</tr>
<tr>
<td>ALP (IU/L)</td>
<td>165.33±8.90b</td>
<td>8.25±205.20±</td>
<td>7.25d 230.05±</td>
<td>35.20d 245.5±</td>
<td>4.45±96.45±</td>
</tr>
<tr>
<td>TBIN (mg/dl)</td>
<td>0.02b 2.45±</td>
<td>0.03b 2.65±</td>
<td>0.04± 3.05±</td>
<td>0.05± 3.25±</td>
<td>0.05± 0.55±</td>
</tr>
<tr>
<td>Alb (g/dl)</td>
<td>1.85±0.30b</td>
<td>0.04±1.25±</td>
<td>1.05±0.20d</td>
<td>ld 0.1 1.06±</td>
<td>0.23±4.85±</td>
</tr>
</tbody>
</table>

Data presented as Mean ± SE IU/L International Unit per Liter SGOT (Serum Glutamic-Oxaloacetic Transaminase) - Normal Range 10-34 IU/L SGPT (Serum Gamma Glutamyl Transpeptidase) - Normal Range 1-50 IU/L ALP (Alkaline Phosphatase) - Normal Range 44-147 IU/L TBIN (Total Bilirubin) - Normal Range 03-1.9 mg/dl Alb (Albumin) - Normal Range 3.4 - 5.4 g/dl

Data presented in table (3) illustrate the effect of feeding different concentration of Strawberry extracts on kidney functions in normal and hepatitis rats after 4 weeks of feeding.

Creatinine and BUN values were (0.70 ± 0.02 and 10.12± 0.55) mg/dl for the normal rats group. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts showed that creatinine levels were (3.55±0.06, 2.20±0.03, 2.65±0.08, and 3.15±0.04) mg/dl for (positive control, 15%, 10%, and 5% Strawberry extracts), respectively. The results proved significant differences between all the groups of WGS when compared with negative control.

BUN values for control (-) group was (10.12±0.55) mg/dl. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum BUN values (22.10±0.25, 12.40±0.60, 16.25±0.20, and 18.40±0.10) mg/dl, respectively. The results declared non significant differences between all groups of Strawberry extracts when compared with negative control.

The present results are going in the same line with Nakagaw et al., (2005). They showed that the effect of proanthocyanidin on rats which have renal ischemia-reperfusion. The increase of thiobarbituric acid (TBA) in kidney and alteration of activity of antioxidant enzyme (dismutes, catalase and glutathione peroxides). They found that proanthocyanidin has protective effect against renal ischemia-reperfusion by reducing the level of (TBA). It also increased activity of antioxidant enzymes.
Table (3): Effect of feeding different concentration of Strawberry extracts on kidney functions of rats with carbon tetra chloride induced hepatitis

<table>
<thead>
<tr>
<th>Kidney Function</th>
<th>15% Strawberry extracts</th>
<th>10% Strawberry extracts</th>
<th>5% Strawberry extracts</th>
<th>Control (+)</th>
<th>Control(-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine (mg/dl)</td>
<td>2.20± 0.03b</td>
<td>2.65± 0.08c</td>
<td>3.15± 0.03</td>
<td>3.55± 0.06d</td>
<td>0.70± 0.02a</td>
</tr>
<tr>
<td>BUN (mg/dl)</td>
<td>12.40± 0.60b</td>
<td>16.25±0.20c</td>
<td>18.40±0.10C</td>
<td>22.10± 0.25d</td>
<td>10.12±0.55a</td>
</tr>
</tbody>
</table>

Data presented as Mean ± SE Normal Range of Creatinine is 0.6 -1.2 mg/dl BUN (Blood Urea Nitrogen) - Normal Range 7 — 20 mg/dl

Table (4) represent the effect of feeding different concentration of Strawberry extracts on serum ferritin, hemoglobin, hematocrite values in normal and hepatitis rats after 4 weeks of feeding.

**Serum Ferritin** value in normal rats group was (48.2±3.1) pg/L. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum ferritin values (36.3±2.25, 44.9±2.50, 38.25±0.03, and 36.9±4.45) pg/L, respectively. The results showed significant differences between all groups of Strawberry extracts when compared with negative control.

**Hemoglobin** value in normal rats group was (11.92±0.12) g/L. While in hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts were (8.20±0.11, 10.95±0.2, 10.66±0.25, and 9.15±0.33) g/L for (positive control, 15%, 10%, and 5% Strawberry extracts), respectively. The results proved significant difference between all groups of Strawberry extracts when compared with negative control.

**Hematocrite** value in normal rate group was (37.25±2.5) %. While in hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts were (30.20±2.2, 35.20±4.15, 34.6±2.2, and 31.65±5.4) % for (positive control, 15%, 10%, and 5% Strawberry extracts), respectively. The results demonstrated significant differences between 5%, 10% and 15% Strawberry extracts when compared with negative control.

Table (4): Effect of feeding different concentration of Strawberry extracts on iron indices of rats with carbon tetra chloride induced hepatitis

<table>
<thead>
<tr>
<th>Tron Indices</th>
<th>15% Strawberry extracts</th>
<th>10% Strawberry extracts</th>
<th>5% Strawberry extracts</th>
<th>Control (+)</th>
<th>Control(-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum ferritin</td>
<td>44.9± 2.50b</td>
<td>38.25± 0.03</td>
<td>4/5° 36.9±</td>
<td>36.3±2.25c</td>
<td>3.1± 48.2</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>± 10.95 0.2a</td>
<td>10.66 ±0.25b</td>
<td>0.33° 9.15±</td>
<td>r 0.1 ± 8.20</td>
<td>0.12± ± 11.92</td>
</tr>
<tr>
<td>Hematocrite</td>
<td>± 35.20 4.15b</td>
<td>2.2b 34.60±</td>
<td>± 31.65 5.4c</td>
<td>±3.3c 30.20</td>
<td>±2.5° 37.25</td>
</tr>
</tbody>
</table>
2) Immunological results

Table (5) represents the effect of feeding different concentration of Strawberry extracts on immunity indices (serum IgG, serum IgM and total immunoglobulin) in normal and hepatitis rats after 4 weeks of feeding.

**Serum IgG** value in normal rats group was (2850.5±350.10) U/ml. While hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts (positive control, 15%, 10%, and 5% Strawberry extracts) showed serum IgG values (1500.7±300.51, 2540.9±210.50, 2350.60±100.30, and 1800.6±250.2) U/ml, respectively. The results demonstrated non significant differences between 5%, 10% and 15% Strawberry extracts when compared with negative control.

**Serum IgM** value in normal rats group was (380.92±15.12) U/ml. While in hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts were (190.55±10.24, 295.40±10.22, 260.40±45.30, and 210.60±15.50) U/ml, for (positive control, 15%, 10%, and 5% Strawberry extracts), respectively. The results declared significant differences between 5%, 10% and 15% Strawberry extracts when compared with negative control.

**Total immunoglobulin** value in normal rats group was (3650.25±200.5) U/ml. While in hepatitis rats groups fed on basal and supplemented diets with different levels of Strawberry extracts were (2232.78±65.2, 3000.45±65.45, 2700.50±20.50, and 2530.15±60.4) U/ml, for (positive control, 15%, 10%, and 5% Strawberry extracts), respectively. The results confirmed the significant differences between 10% and 15% Strawberry extracts when compared with negative control.

**Table (5): Effect of feeding different concentrations of Strawberry extracts on immunity indices of rats with carbon tetra chloride induced hepatitis**

<table>
<thead>
<tr>
<th>Immunity Indices</th>
<th>15% Strawberry extracts</th>
<th>10% Strawberry extracts</th>
<th>5% Strawberry extracts</th>
<th>Control (+)</th>
<th>Control(-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IgG (U/ml)</td>
<td>2540.9±210.50</td>
<td>2350.6±100.30</td>
<td>1800.6±250.20</td>
<td>1500.7±300.51</td>
<td>2850.5±350.10</td>
</tr>
<tr>
<td>IgM (U/ml)</td>
<td>295.40±10.22</td>
<td>260.40±45.30</td>
<td>210.60±15.50</td>
<td>190.55±10.24</td>
<td>380.92±15.12</td>
</tr>
<tr>
<td>Total Immunoglobulin (U/ml)</td>
<td>3000.45±65.45</td>
<td>2700.50±20.50</td>
<td>2530.15±60.4</td>
<td>2232.78±65.2</td>
<td>3650.25±200.5</td>
</tr>
</tbody>
</table>

GPX (Glutathione Peroxidase GSH (Glutathione))

**VI. RECOMMENDATION**

1. Results recommended to hepatic patients to added Strawberry extracts in their diet because it contains useful component that cracterized with immunological properties.

**REFERENCES**


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