Anti-obesity Effect of Gooseberry (*Physalis peruviana*) Fruits in-Induced Obese Rats

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**Abstract:**

The effect of different concentrations (5&10%) as powder and 250 & 500mg/kg as extract of gooseberry fruits (*Physalis peruviana*) on obese rats were evaluated. Thirty six male albino rats weighting 140 ±10 g were used in this study and divided into 6 groups, each group contain 6 rats. Rats were treated by high fat diet (10% animal fat) to induce obese. Results showed that the highest body weight gain, feed intake and feed efficiency ratio recorded for 250 mg/kg gooseberry fruits extract, while the lowest recorded for 10% gooseberry fruits as powder with significant difference. The lower ALT, AST and ALP liver enzyme of treated group recorded for group fed on 500 mg/kg gooseberry fruits extract with significant difference. The highest cholesterol and triglycerides levels recorded for group fed on 5% gooseberry fruit powder while, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference. The highest (HDL-c) levels recorded for group fed on 500 mg/kg gooseberry fruit extract. The lowest LDL-c and VLDL-c values recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference. While, the lowest uric acid, urea and creatinine values recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference. As conclusion, obese rats treated with 500 mg/kg gooseberry fruit extract had improvement lipid profile, liver and kidney functions compared with gooseberry fruit powder.

Key words: Gooseberry fruits, Rats, Anti-obesity and Biochemical analysis.

**Introduction**

Obesity is the most prevalent health problem. It is also known to be a risk factor for the development of metabolic disorders such as type 2 diabetes, systemic hypertension, cardiovascular disease, dyslipidemia, and atherosclerosis. Obesity is a pathological condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems (*Cheng et al.*, 2010).

Hassan and El-Gharib, (2015) concluded that obesity is becoming one of the most prevalent health concerns among all populations and age groups worldwide, resulting in a significant increase in mortality and morbidity related to coronary heart diseases, diabetes type 2, metabolic
syndrome, stroke, and cancers. Disappointing results after cessation the lifestyle modification or pharmacotherapy compelled the researchers and physicians to rethink to find a new, safe, and striking therapeutic alternative for this global health concern. Many natural products act as anti-obesity through various mechanisms to reduce body weight and its complications.

Also, obesity is generally defined as the abnormal or excessive accumulation of fat in adipose tissue to the extent that health may be impaired (Aronne and Segal, 2002).

Cape gooseberry (Physalis peruviana, L.), known locally in Egypt as harankash and known in English speaking countries as cape gooseberry or goldenberry, has many medicinal and edible uses as a promising fruit (Ramadan, 2011).

Many Physalis species are called ground cherries. One name for Physalis peruviana is Inca berry; another is cape gooseberry, not to be confused with the true gooseberries, which are of the genus Ribes in the family Grossulariaceae. Other names used to refer to the fruit are poha berries, and simply golden berries (Vargas, 2001).

Generally, the fruit of P. peruviana, L. is consumed fresh; it provides an acid-sweet balance of fruit and vegetable salads. Also, the whole fruit can be used in syrup and dried as it becomes a “very nice raisin”. The fruit of P. peruviana L. is also used in sauces and glazes for meats and seafood. Also it can be used as preservative for jams and jellies (National Research Council, 1989).

Puente et al. (2011) reported that phytosterols are found in high levels in the oils extracted from the fruit of P. peruviana, L., they would give them properties such as antioxidant and hypocholesterolemic effects, the presence of three specific phytosterols: campesterol, ß-sitosterol and stigmasterol would be responsible for lower levels of blood cholesterol. Furthermore, the antioxidant activity associated with this result is due to the high levels of polyphenols and high in vitamins A and C. Finally, the presence of exclusive Physalis-gender physalins and withanolides specific from the Solanaceae family would give the fruit of P. peruviana, L. anti-inflammatory, antimicrobial and anticancer properties.

Ramadan (2012) suggested that consumption of goldenberry has hypocholesterolemic activities in rats fed HCD. In addition, goldenberry supplementation seems to protect the liver in response to oxidative stress as well as alleviate the magnitude of fatty liver development in response to HCD. It could be suggested that the use of goldenberry by patients suffering from coronary atherosclerosis would prevent the development of
this disease. The beneficial effects could be also related to minor components, especially flavonoids, which are proposed to exert their action by inhibiting LDL oxidation and platelet aggregation and caroteinoides, which are thought to act mainly as antioxidants.

This work was conducted to study the effect of gooseberry fruit powder and its extracts on biochemical analysis of obese rats.

**Material and Methods:**

**Materials:**

Gooseberry (*Physalis peruviana*, L.) fruits were obtained from local market, Shebin El-Kom City, Menoufia Governorate, Egypt.

**The induction of experimental obesity:**

Obesity was induces in normal healthy male albino rats by fed on high fat diet (10% animal lipid) supplemented in the basal diet and used as a positive control group.

**Casein, cellulose, choline chloride, and DL- Methionine**

Casein, cellulose, choline chloride powder, and DL- methionine powder, were obtained from Morgan Co. Cairo, Egypt.

**Experimental animals:**

A total of 36 adult normal male albino rats Sprague Dawley strain weighing 140±10 g were obtained from Vaccine and Immunity Organization, Ministry of Health, Helwan Farm, Cairo, Egypt.

**The chemical kits:**

Chemical kits used for determination the (TC, TG, HDL-c, ALT, AST, ALP, urea, uric acid and creatinine) were obtained from Al-Gomhoria Company for Chemical, Medical and Instruments, Cairo, Egypt.

**Methods:**

**Preparations of herb leaves:**

To prepare the dried gooseberry fruit was obtained from local market. Fruits were washed thoroughly under running tap water, shade dried, and ground to a fine powder using an air mill.

**Experimental design:**

Thirty six adult male white albino rats, Sprague Dawley Strain, 10 weeks age, weighing (140±10g) were used in this experiment. All rats were fed on basal diet (casein diet) prepared according to AIN, (1993) for 7 consecutive days. After this adaptation period, rats are divided into 5
groups, each group which consists of six rats as follows: group (I): rats fed on basal diet as negative control. Group (2): Obese rats induced by fed on high fat diet (10% animal lipid) supplemented in the basal diet and used as a positive control group. Group (3): A group obese rats fed on gooseberry fruit as powder by 5% of the weight of basal diet. Group (4): A group infected obese rats fed on gooseberry fruit as powder by 10% of basal diet. Group (5): A group infected obese rats fed on gooseberry fruit extract by 250 mg/kg of the weight of the rat. Group (6): A group infected obese rats fed on gooseberry fruit extract by 500 mg/kg of the weight of the rat.

During the experimental period, the body weight and feed intake were estimated weekly and the general behavior of rats was observed. The experiment period was take 28 days, at the end of the experimental period each rat weight separately then, rats are slaughtered and collect blood samples. Blood samples were centrifuged at 4000 rpm for ten minute to separate blood serum, and then kept in deep freezer till using.

**Blood sampling:**

After fasting for 12 hours, blood samples in initial times were obtained from retro orbital vein, while it obtained from hepatic portal vein at the end of each experiment. Blood samples were collected into a dry clean centrifuge glass tubes and left to clot in water bath (37°C) for 30 minutes, then centrifuged for 10 minutes at 4000 rpm to separate the serum, which were carefully aspirated and transferred into clean cuvette tube and stored frozen in deep freezer till analysis according to method described by Schermer (1967).

**Body weight gain (BWG), feed intake (FI), and feed efficiency ratio (FER):**

During the experimental period (28 days) the net feed intake was daily recorded, while body weight was weekly recorded. The net feed intake and gained body weight were used for the calculation of feed efficiency ratios (FER) according to Chapman *et al.*, (1959) as follow:

\[
FER\% = \frac{\text{Bodyweight gain (g)}}{\text{Feed intake (g)}} \times 100
\]

**Biochemical analysis:**

**Lipids profile:**

**Determination of total cholesterol:**

Serum total cholesterol was determined according to the colorimetric method described by Thomas (1992).
Determination of serum triglycerides:

Serum triglyceride was determined by enzymatic method using kits according to the Young, (1975) and Fossati, (1982).

Determination of high density lipoprotein (HDL-c):

HDL-c was determined according to the method described by Friedewaid (1972) and Grodon and Amer (1977).

Calculation of very low density lipoprotein cholesterol (VLDL-c):

VLDL-c was calculated in mg/dl according to Lee and Nieman (1996) using the following formula:

\[ VLDL-c \text{ (mg/dl)} = \frac{\text{Triglycerides}}{5} \]

Calculation of low density lipoprotein cholesterol (LDL-c):

LDL-c was calculated in mg/dl according to Lee and Nieman (1996) as follows:

\[ LDL-c \text{ (mg/dl)} = \text{Total cholesterol} - \text{HDL-c} - \text{VLDL-c} \]

Liver functions:

Determination of serum alanine amino transferase (ALT), serum asparatate amino transferase (AST), serum alkaline phosphatase (ALP) were carried out according to the method of Hafkenscheid (1979), Clinica Chimica Acta (1980), and Moss (1982), respectively.

Kidney functions:

Determination of serum urea:

Serum urea and serum creatinin were determined by enzymatic method according to Henry (1974) and Patton & Crouch (1977).

Statistical analysis:

The data were analyzed using a completely randomized factorial design (SAS, 1988) when a significant main effect was detected; the means were separated with the Student-Newman-Keuls Test. Differences between treatments of (P≤0.05) were considered significant using Costat Program. Biological results were analyzed by One Way ANOVA.
Results and Discussion:

Effect of gooseberry fruit powder and its extracts on body weight gain, feed intake and feed efficiency ratio of obese rats:

Table (1): Effect of gooseberry fruits powder and its extracts on body weight gain, feed intake and feed efficiency ratio of obese rats

<table>
<thead>
<tr>
<th>Parameters</th>
<th>BWG (g)</th>
<th>FI (g/day)</th>
<th>FER (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M ± SD</td>
<td>M ± SD</td>
<td>M ± SD</td>
</tr>
<tr>
<td>Control group (-)</td>
<td>20.15±0.20d</td>
<td>18.45±1.24b</td>
<td>0.039d ± 0.002</td>
</tr>
<tr>
<td>Control group (+)</td>
<td>58.23±0.32a</td>
<td>24.75±1.23a</td>
<td>0.084a ± 0.004</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (5%)</td>
<td>39.41±0.11bc</td>
<td>18.48±1.10b</td>
<td>0.076b ± 0.001</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (10%)</td>
<td>33.62±0.50c</td>
<td>17.27±1.25b</td>
<td>0.044c ± 0.002</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (250 mg/kg)</td>
<td>50.65±0.61b</td>
<td>22.70±1.12a</td>
<td>0.080b ± 0.003</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (500 mg/kg)</td>
<td>48.32±0.12b</td>
<td>22.12±1.31a</td>
<td>0.078b ± 0.005</td>
</tr>
<tr>
<td>LSD</td>
<td>3.561</td>
<td>1.578</td>
<td>0.021</td>
</tr>
</tbody>
</table>

Each value is represented as mean ± standard deviation (n = 6).
Mean under the same column bearing different superscript letters are different significantly (p < 0.05).

Data presented in Table (1) show the effect of gooseberry fruit on body weight gain (BWG), feed intake (FI) and feed efficiency ratio (FER) of obese rats. The obtained results showed that the body weight gain (BWG) % of positive control recorded the highest value when compared with negative control with significant difference. The mean values were 58.23 and 20.15%, respectively. From obese rat groups, it is clear to notice that the highest (BWG)% recorded for 250 mg/kg gooseberry fruit extract, while the lowest BWG% recorded for 10% gooseberry fruit powder with significant difference (P≤0.05). The mean values were 50.65 and 33.62%, respectively.

In case of feed intake (FI), it could be notice that the feed intake of positive control recorded the highest value when compared with negative control with significant difference. The mean values were 24.75 and 18.45 g/day, respectively. From obese rat groups, it is obvious that the highest feed intake recorded of 250 mg/kg gooseberry fruit extract, while the lowest FI recorded for 10% gooseberry fruit powder with significant difference (P≤0.05). The mean values were 22.70 and 17.27 g/day, respectively. The obtained results indicated that the highest feed efficiency
ratio recorded for positive control group, while the lowest value recorded for negative control group with significant differences. The mean values were 0.084 and 0.039 %, respectively.

On the other hand, the highest feed efficiency ratio of treated group recorded that 250 mg/kg gooseberry extract, while the lowest FER recorded for 10% gooseberry powder with significant differences. The mean values were 0.080 and 0.044g, respectively. These results are in agreement with Ahmed, (2014), they reported that the final body weights of cisplatin groups that were pretreated with gooseberry extract at 100 or 150 mg/kg BW were higher than their corresponding control representing 178.3 ± 3.6 and 180.5 ± 4.1 g, respectively. Treatment with single dose of cisplatin caused marked reduction in feed intake (7.12 ± 1.9 g/day) compared to normal control group (12.63 ± 2.1 g/day). Furthermore, the feed intake of rats in PPE100 and PPE150 groups with or without cisplatin injection had insignificant mean feed intake when compared with normal control group.

**Effect of gooseberry fruit on liver functions level of obese rats:**

**Table (2): Effect of gooseberry fruits powder and its extracts on liver functions of obese rats**

<table>
<thead>
<tr>
<th>Treatment/Parameter</th>
<th>ALT (U/L)</th>
<th>AST (U/L)</th>
<th>ALP (U/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group (-)</td>
<td>30.26 ± 1.90f</td>
<td>18.86 ± 1.20f</td>
<td>30.61± 1.60f</td>
</tr>
<tr>
<td>Control group (+)</td>
<td>93.18 ± 2.13a</td>
<td>84.65 ± 1.12a</td>
<td>72.05± 1.11a</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (5%)</td>
<td>77.50 ± 1.63b</td>
<td>51.50 ± 1.10b</td>
<td>57.42±1.30b</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (10%)</td>
<td>64.23 ± 1.21c</td>
<td>45.31 ± 1.25c</td>
<td>42.17±1.16d</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (250 mg/kg)</td>
<td>58.72 ± 2.10d</td>
<td>41.45 ± 2.31d</td>
<td>49.45± 2.23c</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (500 mg/kg)</td>
<td>41.60 ± 3.23c</td>
<td>26.27 ± 1.20e</td>
<td>38.24± 2.10c</td>
</tr>
<tr>
<td>LSD</td>
<td>0.26</td>
<td>0.17</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Each value is represented as mean ± standard deviation (n = 6). Mean under the same column bearing different superscript letters are different significantly (p < 0.05).

Data given in Table (2) show the effect of gooseberry fruit on liver functions (ALT, AST and ALP) of obese rats. The obtained results indicated that the ALT liver enzyme of positive control rats group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 93.18 and 95.0 U/L, respectively. While, the highest ALT liver enzyme of treated group recorded for group fed on 5 % gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with
significant difference (P≤0.05). The mean values were 77.50 and 41.60 U/L, respectively. On the other hand, AST liver enzyme of positive control rats group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 84.65 and 18.86 U/L, respectively. While, the highest AST liver enzyme of treated group recorded for group fed on 5 % gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference (P≤0.05). The mean values were 51.50 and 26.27 U/L, respectively. In case of ALP liver enzyme of positive control rats group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 72.05 and 30.61 U/L, respectively. While, the highest ALP liver enzyme of treated group recorded for group fed on 5 % gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference (P≤0.05). The mean values were 75.42 and 38.24 U/L, respectively.

The best treatment observed the highest reduction in liver enzymes recorded for 500 mg/kg gooseberry fruit extract. These results are in agreement with Arun, (2007), they found that gooseberry was rich in flavonoids it is having hepatoprotective effect studies suggest that the aqueous and ethanol extracts prepared from the whole plant of these species were evaluated for their antihepatoma activity. Jyothibasu and Venkata (2015), reported that Physalis peruviana scavenges free radicals that are produced by CCl₄, increases the activity of antioxidant-defense system and a greater susceptibility of the kidney to oxidant stress might be anticipated. Therefore, Physalis extract may be used as a potential dietary antioxidant to retard aging and preventing diseases caused by ROS or ameliorating oxidative damage in tissues.

**Effect of gooseberry fruit on total cholesterol and triglycerides level of obese rats:**

Table (3): Effect of gooseberry fruits powder and its extracts on serum total cholesterol and triglycerides of obese rats

<table>
<thead>
<tr>
<th>Treatment/Parameter</th>
<th>Total cholesterol (mg/dl)</th>
<th>Triglycerides (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group (-)</td>
<td>71.45±4.74⁴</td>
<td>67.20±3.24³</td>
</tr>
<tr>
<td>Control group (+)</td>
<td>159.16±5.18⁴</td>
<td>129.35± 2.61¹</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (5%)</td>
<td>100.60±4.23²</td>
<td>87.12±4.38¹</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (10%)</td>
<td>95.15±5.66³</td>
<td>83.43±4.61²</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (250 mg/kg)</td>
<td>77.63± 4.26⁴</td>
<td>69.42± 2.51²</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (500 mg/kg)</td>
<td>72.18± 2.77⁴</td>
<td>65.78± 3.72³</td>
</tr>
<tr>
<td>LSD</td>
<td>0.26</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Each value is represented as mean ± standard deviation (n = 6). Mean under the same column bearing different superscript letters are different significantly (p < 0.05).
The effect of gooseberry fruit on the serum total cholesterol and triglycerides of obese rats are shown in Table (3). The obtained results indicated that the cholesterol levels of positive control group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 159.16 and 71.45 mg/dl, respectively. While, the highest cholesterol levels recorded for group fed on 5 % gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference (P≤0.05). The mean values were 100.60 and 72.18 mg/dl, respectively.

On the other hand, the triglyceride of positive control group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 129.35 and 67.20 mg/dl, respectively. While, the highest triglyceride recorded for group fed on 5 % gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference (P≤0.05). The mean values were 87.12 and 65.78 mg/dl, respectively. These results are in agreement with Wu et al. (2007), they reported that the fruit of physalis species are highly nutritious, having high levels of vitamins A, B and C. The main active components of vitamin A in fruits are a-carotene, b-carotene and b-cryptoxanthin. The phytosterols are of great interest because of its antioxidant capacity and impact on both total cholesterol and LDL cholesterol.

Effect of gooseberry fruit on lipid profile level of obese rats:

Table (4): Effect of gooseberry fruits powder and its extracts on lipid profile of obese rats

<table>
<thead>
<tr>
<th>Treatment/Parameter</th>
<th>(HDL-C) (g/dl)</th>
<th>(LDL-C) (g/dl)</th>
<th>(VLDL-C) (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group (-)</td>
<td>35.39±2.60c</td>
<td>22.62±1.74c</td>
<td>13.44±0.21c</td>
</tr>
<tr>
<td>Control group (+)</td>
<td>45.88±4.50a</td>
<td>57.60±1.77b</td>
<td>25.87±0.13c</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (5%)</td>
<td>42.20±4.28b</td>
<td>27.50±1.75b</td>
<td>17.42±0.20c</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (10%)</td>
<td>40.35±5.26b</td>
<td>26.39±1.87b</td>
<td>16.69±0.42c</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (250 mg/kg)</td>
<td>45.50±5.11a</td>
<td>10.04±1.75d</td>
<td>13.88±0.10b</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (500 mg/kg)</td>
<td>46.73±4.47a</td>
<td>5.89±1.87d</td>
<td>13.16±0.70b</td>
</tr>
<tr>
<td>LSD</td>
<td>0.26</td>
<td>0.17</td>
<td>0.02</td>
</tr>
</tbody>
</table>

HDL-C = High density lipoprotein cholesterol. LDL =Low density lipoprotein cholesterol
VLDL = Very low density lipoprotein cholesterol
Each value is represented as mean ± standard deviation (n = 6)
Mean under the same column bearing different superscript letters are different significantly (p < 0.05).
The effect of gooseberry fruits on serum lipid profile (HDL-c, LDL-c and VLDL-c) level of obese rats was shown in Table (4). The obtained results indicated that the high density lipoprotein (HDL-c) levels of positive control group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 45.88 and 35.39 mg/dl, respectively. While, the highest (HDL-c) levels recorded for group fed on 500 mg/kg gooseberry fruit extract but, the lowest value recorded for group fed on 10% gooseberry fruit powder with significant difference (P≤0.05). The mean values were 46.73 and 40.35 mg/dl, respectively.

Data also showed that the low density lipoprotein (LDL-c) levels of positive control group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 57.60 and 22.62 mg/dl, respectively. While, the highest (LDL-c) levels recorded for group fed on 5% gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference (P≤0.05). The mean values were 27.50 and 5.89 mg/dl, respectively.

In case of very low density lipoprotein (VLDL-c) levels, the positive control group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 25.87 and 13.44 mg/dl, respectively. While, the highest (VLDL-c) levels recorded for group fed on 5% gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference (P≤0.05).

The mean values were 17.42 and 13.16 mg/dl, respectively. These results are in agreement with Anju and Hiteswar (2013), they seen that concomitant administration of the gooseberry fruit extract at a dose of 1 gm/kg body weight along with high fat diet in the experiment animals, showed a significant decrease in all the lipid parameters (p< 0.01) with a significant rise in the value of HDL (p< 0.01).
Effect of gooseberry fruit on kidney functions level of obese rats:

Table (5): Effect of gooseberry fruits powder and its extracts uric acid, urea and creatinine of obese rats

<table>
<thead>
<tr>
<th>Treatment/Parameter</th>
<th>Uric acid (mg/dl)</th>
<th>Urea (mg/dl)</th>
<th>Creatinine (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group (-)</td>
<td>6.67±0.10&lt;sup&gt;b&lt;/sup&gt;</td>
<td>23.03±0.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.95±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Control group (+)</td>
<td>9.23±0.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>34.52±0.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.42±0.03&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (5%)</td>
<td>6.97±0.20&lt;sup&gt;b&lt;/sup&gt;</td>
<td>20.71±0.30&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.86±0.05&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits powder (10%)</td>
<td>6.60±0.21&lt;sup&gt;b&lt;/sup&gt;</td>
<td>20.32±0.15&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.79±0.02&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (250 mg/kg)</td>
<td>6.03±0.30&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>19.49±0.33&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.84±0.03&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Obese rats with gooseberry fruits extract (500 mg/kg)</td>
<td>5.78±0.25&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18.18±0.10&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.71±0.04&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>LSD</td>
<td>0.26</td>
<td>0.17</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Each value is represented as mean ± standard deviation (n = 6).

Mean under the same line bearing different superscript letters are different significantly (p < 0.05).

Data presented in Table (5) show the effect of gooseberry fruit on the kidney functions (uric acid, urea and creatinine) level of obese rats. It is clear to notice that the uric acid levels of positive control group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 9.23 and 6.67 mg/dl, respectively. While, the highest uric acid levels recorded for group fed on 5% gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference (P≤0.05). The mean values were 6.97 and 5.78 mg/dl, respectively.

Data also indicated that the urea levels of positive control group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 34.52 and 23.03 mg/dl, respectively. While, the highest urea levels recorded for group
fed on 5% gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference (P≤0.05). The mean values were 20.71 and 18.18 mg/dl, respectively.

In case of urea levels, data showed that the positive control group recorded the highest value when compared with negative control group with significant difference (P≤0.05). The mean values were 1.42 and 0.95 mg/dl, respectively. While, the highest urea levels recorded for group fed on 5% gooseberry fruit powder but, the lowest value recorded for group fed on 500 mg/kg gooseberry fruit extract with significant difference (P≤0.05). The mean values were 0.86 and 0.71 mg/dl, respectively.

These results are in agreement with Mpiana et al. (2016), they reported that serum creatinine is a good indicator of kidney function because any elevated serum is associated with failure of nephron function. Therefore, our results showed that daily administration of Physalis peruviana is not affected in general, renal functions.
References:


The anti-obesity effect of gooseberry (Physalis peruviana) fruits in induced obese rats

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The effect of the introduction of gooseberry (Physalis peruviana) fruits on the weight of the obese rats

The study evaluated the anti-obesity effect of gooseberry (Physalis peruviana) fruits in induced obese rats. A total of 36 rats were divided into 6 groups. Each group was fed a diet containing 10% of the total diet calories from either oleic acid or gooseberry fruits. The body weight and food intake of the rats were measured over a period of 6 months. The results showed a significant reduction in body weight and food intake in the rats fed the gooseberry fruits compared to the control group. The study concluded that gooseberry fruits have a potential anti-obesity effect in induced obese rats.

Key words: Gooseberry - Anti-obesity - Fruits - Obese rats.