Influence of Dried Lemon, Ginger and Cumin in Weight Reduction and Some Biochemical Parameters in Rats Suffering from Obesity

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ABSTRACT

The present study was established to study the effect of dried lemon, ginger and cumin on the nutritional parameters, lipid parameters, serum glucose, and liver enzymes of rats suffering from obesity. Also, this study performed to determine the content of lemon, ginger and cumin of phenolic and Flavonoids as a natural anti-oxidant, recently many experiments performed to assess the role of natural antioxidants in the treatment of obesity. The rats (n=30) were distributed into two main groups, the first main group (n=6 rats) fed on basal diet as a control negative group. The second main group (n=24 rats) received high fat diet for 6 weeks to induce obesity in rats. After these periods, the mean value of body weight gain% was estimated in the two main groups, also blood samples were collected from all rats to estimate the levels of cholesterol and triglycerides, then the high fat diet group was divided into (4) subgroups (n=6 rats for each), the first subgroup fed on high fat diet as a control positive group. Subgroups 3, 4 and 5 and were fed on high fat diet supplemented with 200mg/kg of dried lemon, ginger and cumin, respectively. The results cleared that, addition of dried lemon, ginger and cumin, respectively to the high fat diet decreased the body weights, in addition to significant decrease in the mean values total lipids profile, serum glucose level, liver enzymes in all treated groups, compared to the positive control groups, while high-density lipoprotein (HDLc) increased. It was concluded that, the dried lemon showed the best effect on body weights, lipid profile, liver functions, and glucose level of obese rats fed on high fat diet. It could also be argued that dried lemon, ginger and cumin are rich in antioxidants such as phenols and Flavones which plays an important role in reducing the level of lipids profile, serum glucose, and liver enzymes and are considered natural anti-obesity.

Keywords: lemon, ginger and cumin, phenolic, flavonoids obesity, rats, lipid profile, glucose, liver enzymes.

INTRODUCTION

Obesity is the most important nutritional disease in develop countries. Obesity is among the most important factors of morbidity and mortality. Obesity accompanied by many diseases including diabetes, hyperlipidemia, hypertension, and cardiovascular diseases (Mazlom et al., 2009). Nowadays use of medicinal plants has become prevalent in the treatment of many diseases. (Kianbakht et al., 2010). Cumin, as one of these medicinal plants, contains more than 100 different chemicals, including essential fatty acids and volatile oils (Mohiti-Ardekani et al., 2011). Cumin may have decreasing effects of blood lipids and weight (Andallu and Rannya, 2010). Citrus fruits contain basic nutrient compounds such as vitamins, minerals, pectin’s, dietary fibers, and bioactive compounds including flavonoids and carotenoids, (Gorinstein et al., 2013). Citrus fruits exhibit important bioactivities, including antioxidant, anti-inflammatory, anti-obesity, anti-cardiovascular and antitumor abilities (Tanaka et al., 2012). Citrus regulated the lipid and triglyceride (Jung et al., 2011). Tangerine peel extracts reduced the plasma and hepatic cholesterol levels of rats (Bok et al., 1999). Ginger (Zingiber officinale Roscoe, Zingiberaceae) is one of the most commonly used spices around the world. (Ali et al., 2008), and demonstrated to have various pharmacological activities such as antiemetic, antiulcer antiinflammatory, antioxidant, anti-platelet, glucose and lipid lowering, cardiovascular and anticancer activities (Nicoll and Henein., 2009). Ginger is used medicinally for its hepatoprotective and anti-oxidant (Abdel-Azeem et al., 2013), antidiabetic and anti-hyperlipidemic (ElRokh et al., 2010), and anti-obesity effects (Mahmoud, 2013). Phenolic compounds have been proven to be successful in attenuating hypercholesterolemia (Rehrah et al., 2007). Moreover, these substances are known by their protective agents in diseases involving oxidative stress (Chen et al., 2007). In this study, we investigated the effect of dried lemon, ginger and cumin on high-fat diet-induced obesity in rats. In addition to determine its natural antioxidants content and its effects on lipids profile, serum glucose and liver enzymes

MATERIALS AND METHODS

Materials: Dried lemon, ginger and cumin were obtained from local market Cairo, Egypt.

Chemical determination

Determination of phenolic compounds: The total phenolic compounds (TP) in dried lemon ginger and cumin were extracted using methanol solvent at solvent to samples ratio of 10:1. Extraction was carried out using a shaking incubator at room temperature for 24 h followed by filtration through whatman No.1 filter paper. The residue was re-extracted in the same manner and the two filtrates were combined (Sobhy et al., 2009).

Determination of total flavonoids: Total flavonoids content were determined using the method of (Ordon et al., 2006). A volume of 0.5 mL of 2% AlCl3 in ethanol solution was added to 0.5 mL of methanol extract. After one hour at room temperature, the absorbance was measured at 420 nm. A yellow color indicated the presence of flavonoids. Extract samples were evaluated at a final concentration of 0.1 mg/mL.

Experimental animal design: Thirty male albino rats (200 - 210g) were kept in individual stainless steel cages under hygienic conditions and fed one week on basal diet ad libitum for adaptation in the animal house of Faculty of Veterinary Medicine, University of Suez Canal. The basal diet consisted of 14 % protein from casein (≥ 80 %), 4% soya oil, 0.25 % choline chloride, 1 % vitamin mixture, 3.5% salt mixture, 5 % cellulose, 0.18 % L- cystine and the remainder is corn starch up to 100% (Reeves et al., 1993). The vitamin mixture was prepared according to (A.O.A.C., 1975) and the salt mixture was prepared according to (Hegested et al., 1941). After a period of adaptation on basal diet (one
week), the rats (n=30) were divided into two main groups, the first main group (n=6 rats) fed on basal diet and kept as a control negative group. The second main group (n=24 rats) received high fat diet for 6 weeks to induce obesity in rats, the high fat diet consisted of 20% fat (19% beef tallow and 1% soya oil to provide essential fatty acids) according to (Min et al., 2004). Blood samples were collected from all rats to estimate the levels of cholesterol and triglycerides (healthy rats recorded 79.00 ± 4.922 mg/dl cholesterol and 39.722 ± 3.203 mg/dl triglycerides), while the second main group recorded (135.878 ± 4.750 mg/dl cholesterol and 68.251 ± 5.231 mg/dl triglycerides), then the high fat diet group was divided into four subgroups (n=6 rats each), the first subgroup fed on high fat diet as a control positive group. The other subgroups (3, 4 and 5) fed on high fat diet supplemented with 200mg/kg of dried lemon, ginger and cumin, respectively. At the end of the experiment, the animals were fasted overnight, then the rats were weighed, anaesthetized and sacrificed, then blood samples were collected from the aorta. The blood samples were centrifuged and serum was separated to estimate some biochemical parameters.

**Biological Determination:** Determination of feed intake, body weight gain and feed efficiency ratio: Feed Intake (FI) was calculated every other day

**Biochemical Determination:** Some biochemical analyses were determination, i.e. serum cholesterol (Allain et al., 1974), triglycerides (Foster and Dumns, 1973), HDL-c (Lopes-Virella et al., 1977), LDL-c and VLDL-c (Fried et al., 1972), glucose (Trinder,1969), aspartate amino transferase (AST) and alanine amino transferase (ALT) (Reitman, and Frankel.,1957),

**Statistical analysis:** Data was presented as means ± SD statistically analyzed using one way ANOVA test, p<0.05 was used to indicate significance (Steel and Torri.,1980).

**RESULTS AND DISCUSSION**

**Phenolic and flavonoid contents.**

According to the data shown in the Table (1). The content of total phenolic and total flavonoids in lemon, varying between 48.83 mg GAE/100 g to 46.19mg CE/100 g, was found to be much higher than and cumin - 29.24 mg GAE/100g to 28.27 mg CE/100g, respectively. Several investigations have mentioned that the antioxidant potential of plants might be due to their phenolic components (Cook et al., 1996). Flavonoids, a group of polyphenolic compounds with known properties, such as free radical scavenging activity, inhibition of hydrolytic and oxidative enzyme and anti-inflammatory action (Pourmorad et al., 2006), have been isolated from plants (Omale and Okafor et al., 2008).

**Table 1. Total phenolic and total flavonoids of dried lemon, ginger and cumin.**

<table>
<thead>
<tr>
<th>Plants</th>
<th>Total phenolics, (mg GAE/100 g)</th>
<th>Total flavonoids, (mg CE/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemon</td>
<td>49.83</td>
<td>46.19</td>
</tr>
<tr>
<td>Ginger</td>
<td>47.33</td>
<td>27.36</td>
</tr>
<tr>
<td>Cumin</td>
<td>29.24</td>
<td>28.27</td>
</tr>
</tbody>
</table>

**Effect of dried lemon, ginger and cumin on food intake, body weight gain % and changes of weight of obese rats.**

The effect of dried lemon, ginger and cumin on feed intake, body weight gain% and changes of weight of obese rats are presented in Table (2).

**Table 2. Effect of dried lemon, ginger and cumin on feed intake, changes of weight of and body weight gain %**

<table>
<thead>
<tr>
<th>Plants</th>
<th>Feed intake (g/day)</th>
<th>Initial weight (g)</th>
<th>Final weight (g)</th>
<th>BWG%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>19.00 ± b</td>
<td>172.50 ± b</td>
<td>195.00 ± f</td>
<td>13.035 ± e</td>
</tr>
<tr>
<td>Control</td>
<td>17.750 ± b</td>
<td>234.750 ± a</td>
<td>307.500 ± a</td>
<td>30.983 ± a</td>
</tr>
<tr>
<td>Lemon</td>
<td>18.500 ± b</td>
<td>239.250 ± a</td>
<td>249.500 ± c</td>
<td>4.281 ± f</td>
</tr>
<tr>
<td>Ginger</td>
<td>16.750 ± b</td>
<td>236.500 ± a</td>
<td>277.500 ± d</td>
<td>17.324 ± c</td>
</tr>
<tr>
<td>Cumin</td>
<td>18.500 ± b</td>
<td>236.500 ± a</td>
<td>257.250 ± e</td>
<td>8.773 ± e</td>
</tr>
</tbody>
</table>

**Feed intake (g/day for each rat).**

The mean value of feed intake in healthy group fed on basal diet (control –ve group) showed non significant differences compared with obese group fed on high fat diet containing 20% fat (control +ve group). Feed intake in all obese groups which were treated with dried lemon, ginger and cumin had non-significant differences of mean value at (p<0.05), compared with the normal group (control –ve group).
20% fat and treated with 200mg/kg of dried lemon, ginger and cumin, respectively led to significant decrease (p<0.05) in the weight at the final of the experiment, as compared to the positive control group. 

Body Weight Gain (BWG %): Body weight gain % of obese rats fed on diet containing 20% fat (control +ve) increased significantly p<0.05, as compared to the negative control group fed on basal diet. On the other side, comparing all treated groups with control +ve group demonstrated significant decrease. Treated group with cumin resulted in the highest decrease in BWG%, as compared to (control +ve) and other treated groups. 

Body weight gain was significantly reduced by feeding with the diet containing lemon polyphenols (Yoshiko et al., 2008). Treatment with dried rhizomes of ginger produced a significant reduction in elevated lipid levels, body weight, hyperglycemia and hyperinsulinemia (Mahmoud and El.nour, 2013)

**Effect of dried lemon, ginger and cumin on Lipid Fractions of Obese Rats.**

The mean values of serum cholesterol, triglycerides, LDL-c and VLDL-c (mg/dl) significantly increased P< 0.05 for control positive group, in comparison with control negative group as shown in table (3). The percentage of increase in cholesterol value was about 74.79 %, while HDL-c value (mg/dl) for control positive group decreased than that of the control negative group by about 48.26 %. Addition of lemon, ginger and cumin resulted in a significant reduction in cholesterol values. Rats which received high fat diets with the previous concentrations of lemon, ginger and cumin had lower mean values of triglycerides, LDL-c and VLDL-c compared with control positive group. On the other hand, the same treated groups of rats had higher mean values of HDL-c than that of the control positive group. The best result for lipid fractions was noticed in the group of rats fed on high fat diet containing cumin(200mg/kg), followed by group that treated with Lemon(200mg/kg) and finally group of rats treated ginger(200mg/kg) (Table 3). Our results are in agreement with many studies which showed that, oral lemon juice administration resulted in significant decrease in serum total cholesterol, triglyceride (TG) and LDL-cholesterol levels when compared with the control group with a commensurate significant increase in the HDL-cholesterol (Olukanni et al., 2013). The serum TG levels of the mice fed the LP (lemon polyphenols) diet were significantly decreased compared to those of the mice fed the LF and HF diet. (Yoshiko et al., 2008). Cinnamon and ginger in doses 200 and 400 mg kg when given orally to obese diabetic rats significantly lowered the high levels of serum TC and TG in a dose- and also induced a significant (P <0.05) increase in serum HDL and decreased in LDL (Mostafa and Hamed., 2014). C. cyminum treatment also resulted in a significant reduction in plasma and tissue cholesterol, phospholipids, free fatty acids and triglycerides (Dhandapani et al., 2002).

**Table 3. Effect of dried lemon, ginger and cumin on lipid fractions of obese rats.**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Cholesterol</th>
<th>Triglycerides</th>
<th>HDL-c</th>
<th>LDL-c</th>
<th>VLDL-c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td>mg/dl</td>
<td>mg/dl</td>
<td>mg/dl</td>
<td>mg/dl</td>
<td>mg/dl</td>
</tr>
<tr>
<td>Control (-)</td>
<td>84.682 e</td>
<td>41.250 f</td>
<td>44.488 a</td>
<td>31.944 b</td>
<td>8.250 f</td>
</tr>
<tr>
<td>± 5.377</td>
<td>± 2.179</td>
<td>± 4.228</td>
<td>± 0.815</td>
<td>± 0.435</td>
<td></td>
</tr>
<tr>
<td>Control (+)</td>
<td>148.013 a</td>
<td>79.665 a</td>
<td>23.020 d</td>
<td>109.059 a</td>
<td>15.932 a</td>
</tr>
<tr>
<td>± 5.502</td>
<td>± 6.008</td>
<td>± 2.264</td>
<td>± 2.420</td>
<td>± 1.201</td>
<td></td>
</tr>
<tr>
<td>Lemon(200mg/kg)</td>
<td>89.210 e</td>
<td>42.180 f</td>
<td>37.368 b</td>
<td>43.405 f</td>
<td>8.436 f</td>
</tr>
<tr>
<td>± 2.075</td>
<td>± 2.517</td>
<td>± 2.137</td>
<td>± 0.566</td>
<td>± 0.503</td>
<td></td>
</tr>
<tr>
<td>Ginger(200mg/kg)</td>
<td>103.534 d</td>
<td>53.215 e</td>
<td>36.010 bc</td>
<td>56.881 e</td>
<td>10.643 e</td>
</tr>
<tr>
<td>± 3.443</td>
<td>± 2.061</td>
<td>± 0.770</td>
<td>± 0.261</td>
<td>± 0.412</td>
<td></td>
</tr>
<tr>
<td>Cumin(200mg/kg)</td>
<td>100.521 d</td>
<td>56.520 de</td>
<td>37.987 b</td>
<td>51.230 f</td>
<td>11.301 de</td>
</tr>
<tr>
<td>± 4.549</td>
<td>± 6.149</td>
<td>± 2.054</td>
<td>± 1.181</td>
<td>± 1.230</td>
<td></td>
</tr>
</tbody>
</table>

**Effect of dried lemon, ginger and cumin on some liver enzymes and serum glucose of obese rats.**

Concerning aspartate and alanine amine transaminase (AST and ALT) and cumin were added to the high fat diet of obese rats a significant decrease of AST and ALT values were noticed in comparison to control positive group. Our results are in agreement with many studies which showed that. Mandarin fruit improved the metabolic function of liver and restored the antioxidant enzymes in diabetic rats (Sugiuwa et al., 2006). Naringin prevented the increase in hepatic enzyme activities (AST, ALP, and ALT) and reduced the accumulation of lipid deposition and fibrosis in the liver of high-carbohydrate, high-fat-diet–fed obese rats (Ashrafual et al., 2014). Previous studies indicated that the administration of aqueous extract of ginger to rats, orally and intraperitoneally, at two different levels of doses, significantly decreased the activities of some serum enzymes such as aspartate aminotransaminase (AST) and alanine aminotransaminase (ALT) (Alnaqeeb et al., 2003). Ginger and silimarin reduced serum ALT, AST, and ALP indicating membrane stabilization and antioxidant properties of ginger (Bhandari et al., 2003). Results obtained from other studies revealed that the values of serum AST and ALT were significantly decreased in rats treated with LTG and ginger 100 mg compared with epileptic group treated with lamotrigine(Ameneh et al., 2014). (Aruna et al., 2005) Indicate that cumin can decrease the lipid levels in...
alcohol and thermally oxidized oil induced hepatotoxicity.

Table 4. Effect of dried lemon, ginger and cumin on some liver enzymes and serum glucose of obese rats.

<table>
<thead>
<tr>
<th>Groups</th>
<th>AST (u/l)</th>
<th>ALT (u/l)</th>
<th>Glucose (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (-)</td>
<td>46.047</td>
<td>21.440</td>
<td>90.427 ± 4.035</td>
</tr>
<tr>
<td>Control (+)</td>
<td>76.810</td>
<td>43.648</td>
<td>151.636 ± 4.833</td>
</tr>
<tr>
<td>Lemon(200mg/kg)</td>
<td>49.934</td>
<td>24.886</td>
<td>93.718 ± 3.148</td>
</tr>
<tr>
<td>Ginger(200mg/kg)</td>
<td>56.192</td>
<td>29.374</td>
<td>104.311 ± 3.590</td>
</tr>
<tr>
<td>Cumin(200mg/kg)</td>
<td>57.051</td>
<td>31.413</td>
<td>116.358 ± 4.238</td>
</tr>
</tbody>
</table>

Also, it could be noticed that, the mean values of serum glucose levels (mg/dl) for all treated groups were decreased significantly, as compared to the positive control group, but the finest results were for groups of rats that fed on diet contained 200mg/kg of dried lemon.

These results are in agreement with much previous study. Glucose levels were substantially reduced in ginger- treated diabetic groups (Al-Noory et al., 2013). Ginger root supplementation significantly lowers blood glucose and levels. When combined with dietary and lifestyle interventions it may be an effective intervention for managing Type 2 diabetes mellitus (James et al., 2015). Consumption of ginger produced a significant antihyperglycemic effect in experimentally induced diabetic rats (Sultan et al., 2014). Treatment with cumin decreased a blood glucose level. This may be through stimulation of surviving β-cells to produce insulin. In addition, it is known that the antioxidant effect of cumin suppressed apoptosis and exerted beneficial effects on pancreas β-cells (Gehan et al., 2016). The researchers attributed the antihyperglycemic and hypoglycemic effects to flavonoids present in cumin, most likely through potentiation of insulin secretion. Based on animal study using diabetic models, cumin (Dhandapani et al., 2002) or a methanolic extract of cumin (Jagtap et al., 2010) resulted in a reduction in blood glucose and glycosylated hemoglobin, and improved serum insulin content when compared to diabetic control rats. C. citratus at a dose of 200 mg/kg body weight decrease the blood glucose level. (Adegbegi et al., 2015).

CONCLUSION

In conclusion, consumption of dried lemon, ginger and cumin at certain levels 200mg/kg in this study may be useful for treatment of obesity because their lowers body weight, lipid profile, liver functions, and serum glucose level Further studies are recommended to determine the medicinal effect of other different fractions of dried lemon, ginger and cumin extract. Also should be noted to the importance of antioxidants in of these herbs and their relation to the treatment of obesity and improving the lips, sugar and liver enzymes.

REFERENCES


Taker the lemons and the oranges can be useful in lowering cholesterol and triglyceride by consuming the juice of the fruits. It is also useful in reducing blood sugar levels.

When it comes to insulin resistance, the compound hesperidin has been shown to be effective in reducing insulin resistance and improving glucose metabolism. This is due to its ability to inhibit the activity of key enzymes involved in glucose metabolism and lipid metabolism.

Overall, citrus fruits are a great addition to a healthy diet due to their numerous health benefits.