Abstract
This study was carried out to evaluate the effect of different levels of avocado juice with Chamomile tea as a source of anti-oxidant and phenolic compounds on body weight gain (BWG), feed intake, feed efficiency ratio, lipid profile, leptin and thyroid hormones on obese rats. Thirty male albino rats were divided into two main groups; the first group (5 rats) fed basal diet used as negative control group. The second group (25 rats) obese rats were divided into 5 sub-groups (5 per each) sub group (1) served as positive control group, sub group 2,3 were fed basal diet and given orally avocado juice in a dose of 2.5 and 5 ml, respectively. Sub group 4,5 were fed basal diet and given orally mixture of avocado juice and chamomile tea in a dose of 2.54 and 5 ml, respectively. The results indicated that treatments significantly decreased the levels of BWG, FER, F, T.G, cholesterol, LDLc, VLDLc, liver enzymes (ALT, AST and ALP), uric acid, urea, creatinine, leptin and TSH as compared with positive control group. On the other hand, the treatments significantly increased HDL, T3 and T4 as compared with positive control. In conclusion, avocado juice can improve lipid profile and thyroid hormones but the maximum improvement recorded for mixture of avocado juice and chamomile tea at the dose of 5 mg.

Keywords: Avocado, chamomile, lipid profile, thyroid hormones, liver function, kidney function, Obesity.

1. Introduction
Obesity has become the first non-infectious inflammatory disease in the history of mankind. It is defined as an excessive or abnormal accumulation of adipose tissue that may impair health (WHO, 2006).

Obesity is a risk factor for several of the leading causes of preventable death, including cardiovascular disease, diabetes mellitus, and many types of cancer. Thus, successful treatment and control of obesity should be major imperatives. However, multiple studies have shown that detection and counseling rates among physicians remain low (Jackson et al. 2005 and Haire-Joshu and Klein 2011).

The Dietary Guidelines are based on evidence that eating a LF (20-35%) diet helps manage weight, promote health, and reduce the risk of
chronic disease. The guidelines include recommendations for “foods to reduce” (i.e., saturated and trans fat, cholesterol, sodium, added sugar, refined grains, alcohol) and “foods to increase” (i.e., fruits, vegetables, whole grains, low-fat dairy and protein foods, oils) in order to maximize the nutrient content and health promoting potential of the diet. Other examples of a LF diet are the DASH diet and those recommended by the American Diabetes Association, American Heart Association, and American Cancer Society, as well as commercial programs like Weight Watchers (Bantle et al. 2008; Lichtenstein et al. 2006 and Kushi et al. 2006).

Avocado, a nutrient-dense and medium-caloric-dense whole food, may help to reduce the risk of weight gain and excess adiposity. Benefits of avocados may be attributed to various components including dietary fiber, phytocemicals, mannoheptulose, and monounsaturated fatty acids (MUFAs) (Paturi et al. 2017).

Phytochemical screening of chamomile flowers revealed its richness in beneficial active molecules such as phenolic compounds and terpenoids (Sebai et al. 2015; McKay and Blumberg, 2006). Due to its antioxidant and anti-inflammatory properties, chamomile extracts exhibit many beneficial health effects such as hepatoprotective, gastro protective and neuroprotective activities (Sebai et al. 2015; Jabri et al. 2016 and Bulgari et al. 2012). Therefore, the present study was performed to examine the effect of avocado juice and chamomile tea on lipid profile and thyroid hormones for obese rats.

2. Materials and Methods

2.1. Materials

- Casein, all vitamins, all minerals, cellulose, cholinchloride and Methionine, were obtained from El-gomhoria Company, Cairo, Egypt.
- Tallow which used in obesity induction, were obtained from local market from Shebin EL-kom, Menoufia, Egypt.
- The kits were supplied by Bio diagnostics company Cairo, Egypt.
- Persea American and Matricaria Recutita L. were obtained from Agricultural Research Center.

2.2. Methods

2.2.1. Induction of obesity:

Twenty five Rat fed on high fat diet to induce the obesity. High fat diet prepared from fine ingredients per 100g according to Negm (2002). The diet contained the following composition: 20% fat (tallow 30%+corn oil 10%), 10% casien (protein) content, mineral mixture 4%, vitamin mixture 1%, cellulose 5%, choline chloride 0.2%, methionine 0.3%, corn starch up to 100% (59.5%).

2.2.2. Preparation of avocado juice

Avocado was carefully washed with tap water, then sliced into small pieces and squeezed it to juice by electric blender with water according to Mohamed and Amr (2013).

2.2.3. Preparation of chamomile tea

Tea was prepared by adding 1 gm chamomile flowers in 150 ml boiling distilled water, covering and leaving to steep for 10-15 min and then allowed to cool for 15 min according to Sairaet al. (2014).

2.2.4. Experimental design and animal groups
The experimental was done in the Faculty of Home Economics, Minufiya University, Shebin El-kom. Thirty white male albino rats, weighting 250±3gm. were used in the study. The animals were obtained from Research center, Giza, Egypt. All rats were fed on basal diet which prepared according to Reeves et al. (1993) for 7 consecutive days. After this adaptation period, rats are divided into two main groups; the first group (5 rats) fed basal diet used as control negative group. The second group (25 rats) obese rats were divided into 5 sub-groups (5 per each) sub group 1) served as positive control group, sub group 2, 3 were fed basal diet and given orally avocado juice in a dose of 2.5 and 5 mg, respectively. Sub group 4, 5 were fed basal diet and given orally mixture of avocado juice and chamomile tea in a dose of 2.54 and 5 mg, respectively. 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 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 3000 rpm for ten minute to separate blood serum, and then kept in deep freezer (-20°C) till using.

2.2.5. Biological evaluation:

The body weight gain (B.W.G.) and feed efficiency ratio (F.E.R) were determined according to Chapman et al. (1959). Using the following equations:

\[ \text{B.W.G.} = (\text{Final weight} - \text{Initial weight}) \]
\[ \text{F.E.R.} = \frac{\text{Grams gain in body weight}}{\text{Grams feed consumed}} \]

2.2.6. Biochemical analysis:

Serum total cholesterol, triglyceride (TG) and high density lipoprotein (HDLc) were determined by using methods of Allain et al. (1974), Fossati and Prencip (1982) and Lopez-virella (1977), respectively. The determination of low density lipoprotein cholesterol (LDLc) and very low density lipoprotein cholesterol (VLDLc) were carried out according to the methods of Lee and Nieman (2019) as follows: 

\[ \text{VLDLv} = \frac{\text{TG}}{5} \quad \text{and} \quad \text{LDLc} = \text{TC} - (\text{HDLc} + \text{VLDLc}) \]

The determination of thyroid stimulating hormone (TSH) carried out according to Uotila et al. (1981). Thyroid hormones (Tetraiodothyronine and Triiodothyronine) were estimated in serum using Radioimmunoassay (RIA) as described by Patrono and Peskar (1987). The determination of leptin hormone carried out according to Cosidine et al. (1996).

2.2.7. Statistical analysis:

Data were statistically analyzed using statistical analysis system (Armitage and Berry, 1987). One way analysis of variance (ANOVA) was used to test the variations among groups and post Hoc test (Duncan's Test) was used to compare group means.

3. Result and Discussion

The effect of different levels of avocado juice and chamomile tea on Feed Intake, feed efficiency ratio and Body weight gain was tabulated.
in table(1). Data presented could be observed that here were significant (p≤0.05) increase in FI:FER and BWG for positive control group (20.13, 1.471 and 29.67g.), respectively. As compared to the healthy rats (negative control group) which were, 14.33, 1.21 and 17.3gm, respectively.

Groups fed on high fat diet and avocado juice showed improving in body weight and feed intake compared to the positive control group, it seems that avocado juice at 2.5 and 5mg a protective effect against overweight. Treated obese groups fed on mixture of avocado juice and chamomile tea showed the best improvement at compared to positive control group and treated groups (3 and 4) by avocado juice. So the best result for BWG, FI and FER was recorded for group (6). These results are in harmony, with those obtained by Naveh et al. (2002) and Fulgoniet al. (2013) who indicated that avocado consumption is associated with lower body weight. Moreover, Maknie et al. (2008) and Barakat (2011) found that the feed efficiency ratio of treated obese groups fed on avocado juice recorded significant decreased (P≤0.05).

Braiet et al. (2007) reported that rats treated with avocado leaf extracts showed decrease in overall body weight gain.

Jabri et al. (2016) showed that treatment with chamomile decoction extract (100 mg/kg) significantly corrected these deleterious effects in body weight gain when compared to high fat diet control group.

Table (1): Effect of different levels of avocado juice and chamomile tea on Feed Intake, feed efficiency ratio and Body weight gain of obese rats

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Control (-ve)</td>
</tr>
<tr>
<td>FI (g)</td>
<td>14.33 ± 0.02</td>
</tr>
<tr>
<td>FER (g)</td>
<td>1.21 ± 0.26</td>
</tr>
<tr>
<td>BWG (g)</td>
<td>17.3 ± 3.51</td>
</tr>
</tbody>
</table>

- All values represented as mean±SD.
- Means with different superscript letters in the same column are significantly different at (p≤0.05).

Effect of different levels of avocado juice and chamomile tea on lipid parameters of obese rats presented intable (2) that the mean values of fasting serum T.C and T.G in positive control groups were (150.33 and 144.63mg/dl), respectively. It being significantly higher when compared to the corresponding values in negative control groups which were (87.43 and 60.23mg/dl), respectively. All treatment obese groups showed significant decrease (p≤0.05) when compared to positive control group. The lowest significant decrease (p≤0.05) recorded for group 5 which fed on mixture of avocado juice and chamomile tea in a dose of 5 mg which was 103.50mg/dl.
At the same table, the results indicated that the mean value of HDL for positive control group was significantly lower than negative control group, which was 22.20 and 47.46 mg/dl, respectively. The best result was recorded for group 5 which fed on mixture of avocado juice and chamomile tea in a dose of 5 mg. As for LDLc, the results showed that the mean value for positive control group was significantly higher than negative control group, which were 99.20 and 72.93 mg/dl, respectively. Rats which received different levels of avocado juice and chamomile tea were decreased significantly (p≤0.05) in serum LDL level when compared to positive control group. It could be noticed that the mean value of group 6 was lower than positive control group which was 52.03 and 99.20 mg/dl so the best result was recorded for group (6). Concerning VLDlc, the results indicated that the mean value of positive control group was significantly higher than negative control group, which were 28.92 and 12.10 mg/dl. The different levels of VLDL in groups of avocado juice and chamomile tea were decreased significantly in serum VLDL level when compared to positive control group. It could be noticed that the mean value of obese rats group fed on mix of avocado juice and chamomile 5 mg was lower than positive control group which was 20.70 and 28.92 mg/dl so the best result was recorded for group (6) which given orally mix of avocado juice and chamomile tea in a dose of 5 mg.

**Table (2): Effect of different levels of avocado juice and chamomile tea on lipid parameters of obese rats**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Groups</th>
<th>((1)) Control (+ve)</th>
<th>((2)) Control (+ve)</th>
<th>((3)) 2.5 mg avocado juice</th>
<th>((4)) 5mg avocado juice</th>
<th>((5)) 5mg avocado juice and chamomile</th>
<th>((6)) 5 mg Avocado juice and chamomile</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC (mg/dl)</td>
<td>(87.43 \pm 0.83)</td>
<td>(120.33 \pm 0.80)</td>
<td>(149.46 \pm 0.95)</td>
<td>(129.46 \pm 1.06)</td>
<td>(138.46 \pm 1.01)</td>
<td>(109.53 \pm 0.80)</td>
<td></td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>(60.23 \pm 1.19)</td>
<td>(144.63 \pm 2.11)</td>
<td>(137.06 \pm 1.33)</td>
<td>(112.83 \pm 1.49)</td>
<td>(123.43 \pm 1.95)</td>
<td>(103.90 \pm 2.10)</td>
<td></td>
</tr>
<tr>
<td>HDLc (mg/dl)</td>
<td>(9.70 \pm 1.09)</td>
<td>(22.20 \pm 1.13)</td>
<td>(20.66 \pm 0.51)</td>
<td>(31.63 \pm 0.58)</td>
<td>(29.76 \pm 0.20)</td>
<td>(36.05 \pm 0.55)</td>
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<tr>
<td>LDLc (mg/dl)</td>
<td>(7.48 \pm 0.48)</td>
<td>(4.97 \pm 0.97)</td>
<td>(9.38 \pm 0.81)</td>
<td>(7.29 \pm 1.15)</td>
<td>(8.70 \pm 0.45)</td>
<td>(9.59 \pm 0.36)</td>
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<tr>
<td>VLDLc (mg/dl)</td>
<td>(5.38 \pm 0.37)</td>
<td>(4.72 \pm 0.34)</td>
<td>(7.69 \pm 0.69)</td>
<td>(6.77 \pm 0.73)</td>
<td>(7.89 \pm 0.84)</td>
<td>(20.04 \pm 0.42)</td>
<td></td>
</tr>
</tbody>
</table>

- All values represented as mean±SD.
- Means with different superscript letters in the same column are significantly different (p<0.05).

In agreement with these findings, Mohamed et al. (2017) reported that rats fed defatted avocado fruit (100 mg/kg body weight/day for 14 weeks) of diet-reduced total hepatic fat levels. In agreement with these findings, Mohamed et al. (2017) reported that rats fed defatted avocado fruit (100 mg/kg body weight/day for 14 weeks) of diet-reduced total hepatic fat levels. In agreement with these findings, Mohamed et al. (2017) reported that rats fed defatted avocado fruit (100 mg/kg body weight/day for 14 weeks) of diet-reduced total hepatic fat levels. In agreement with these findings, Mohamed et al. (2017) reported that rats fed defatted avocado fruit (100 mg/kg body weight/day for 14 weeks) of diet-reduced total hepatic fat levels. In agreement with these findings, Mohamed et al. (2017) reported that rats fed defatted avocado fruit (100 mg/kg body weight/day for 14 weeks) of diet-reduced total hepatic fat levels. In agreement with these findings, Mohamed et al. 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control group and the lowest mean value was in the group (6) fed on mix of avocado juice and chamomile tea. It could be observed that there is no significant differences between group (4) and group (5). There were significant decrease between all treatments groups when compared with positive control group and the best effect was detected in the group (6) fed on mix of avocado juice and chamomile tea with mean value 77.33ng/ml. For T3 hormone, the results showed that the mean value of T3 of positive control group was significantly lower than negative control group, which were 60.74 and 80.232ng/ml, respectively. And showed a significant difference (p≤0.05). All treatments showed significant increase (p≤0.05) when compared with positive control group but the best result was recorded for group (6) fed on mix of avocado juice and chamomile tea 5 mg.

The results showed that the mean value of T4 of positive control group was significantly (p≤0.05) lower than negative control group, which were 1.03 and 3.66ng/ml, respectively. All treatments showed significant increase (p≤0.05) when compared with positive control group and the best result was recorded for group (6) fed on mix of avocado juice and chamomile tea 5 mg.

Concerning TSH, as shown the mean value of TSH of positive control group was significantly higher (p≤0.05) than negative control group, which were 1.57 and 0.12µg/dl, respectively. Also the mean value of groups fed on different levels of avocado juice and chamomile tea were significantly (p≤0.05) decreased when compared to positive control group and the best mean value was recorded of group (6) which was 1.21µg/dl. These findings are in harmony with those of Ahlam et al. (2019), they found that treatment with both chamomile extract resulted in an improvement in serum level of thyroid hormones (TSH, T3 and T4) and the disappearance of most thyroid gland pathological changes demonstrated by light and electron microscopes. Also, in agreement with these findings, Monika and Geetha (2015) reported that the avocado fruit extract influences leptin activity, which controls satiety and hunger to regulate the food intake. Asmaet et al. (2016) reported that treatment with avocado decreased in TSH and increased in T3, T4 on rats. This is due to the fact that avocado contains selenium, zinc, and iodine which can boost thyroid function.

**Table (3): Effect of different levels of avocado juice and chamomile tea on leptin, triiodothyronine (T3), tetraiodothyronine (T4) and thyroid-stimulating hormone (TSH) hormones of obese rats**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Control (-ve)</td>
</tr>
<tr>
<td>Leptin (ng/ml)</td>
<td>53.52±2.41&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>TSH (µg/dl)</td>
<td>0.12±0.02&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>T3 (ng/dl)</td>
<td>80.23±4.49&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>T4 (ng/dl)</td>
<td>3.66±0.15&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

- All values represented as mean±SD.
- Means with different superscript letters in the same column are significantly different at (p≤0.05)
Effect of avocado juice and chamomile tea on liver enzymes (ALT, AST and ALP) of obese rats presented in table (4). Serum levels of ALT, AST and ALP (147, 254.3 and 184.3 U/L, respectively) were significantly higher at (p ≤ 0.05) in untreated obese rats (positive control rats), compared with the normal control rats (66.67, 152.3 and 85 U/L, respectively). Administration of avocado juice at two doses (2.5 and 5 mg) induced significantly lower at (p ≤ 0.05) in serum ALT, AST and ALP concentrations, compared with untreated obese rats. These decreases were more detectable with increasing level of avocado juice. Also, mix of avocado juice and chamomile tea at the two doses (2.5 and 5 mg) induced significantly lower at (p ≤ 0.05) in serum ALT, AST and ALP concentrations, compared with untreated obese rats and obese rats treated with avocado juice. So the best result was recorded for treated obese rats with 5 mg mixture of avocado juice and chamomile tea. In agreement with these findings, Mohamed and Amr (2013) indicated that detected phenolic compounds in avocado caused significant decrease in serum concentrations of AST, ALT and ALP. Similar results were obtained by Folasade et al. (2016); Etab and Fatimah (2017) who reported that avocado can reduce hazards on liver function. Also, Mohamed (2018) showed that chamomile reduced serum levels of ALT and AST. No significant (p > 0.05) different in ALP level between groups.

Table (4): Effect of avocado juice and chamomile tea on liver enzymes (ALT, AST and ALP) of obese rats:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>(1) Control (-ve)</th>
<th>(2) Control (+ve)</th>
<th>(3) 2.5 mg avocado juice</th>
<th>(4) 5mg avocado juice</th>
<th>(5) 2.5 mg avocado juice and chamomile</th>
<th>(6) 5 mg Avocado juice and chamomile</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPT(ALT U/L)</td>
<td>66.67± 1.53f</td>
<td>147 ± 2 a</td>
<td>142.67 ± 2.52b</td>
<td>128 ± 2 d</td>
<td>137.33 ± 2.08c</td>
<td>122.33± 2.517e</td>
</tr>
<tr>
<td>GOT(AST U/L)</td>
<td>152.3± 2.52f</td>
<td>254.3 ± 4.04a</td>
<td>244± 3.61b</td>
<td>204 ± 3.5d</td>
<td>234± 3.5c</td>
<td>194.67±3.1e</td>
</tr>
<tr>
<td>ALP (U/L)</td>
<td>85± 4.16f</td>
<td>184.3 ± 4.17a</td>
<td>174.6 ± 3.51b</td>
<td>184.3 ± 4.50d</td>
<td>166 ± 3.6f</td>
<td>134.6± 3.5f</td>
</tr>
</tbody>
</table>

- All values represented as mean±SD.
- Means with different superscript letters in the same column are significantly different at (p≤0.05).

Effect of avocado juice and chamomile tea on kidney function of obese rats showed in table (5). Results revealed that untreated obese rats (positive control group) had significantly (p≤0.05) higher values of uric acid, urea and creatinine (4.33, 89.30 and 1.03 mg/dl, respectively), compared with those of the
normal healthy rats (1.46, 34 and 0.26mg/dl), respectively. Administration of avocado juice at the two different levels (2.5 and 5mg) induced significantly lower (p≤0.05) in serum activity of uric acid, urea and creatinine, compared with those of untreated obese rats. It obvious those, the decrease in serum activity of uric acid, urea and creatinine were more detectable with increases avocado juice levels. While administration of mixture of avocado juice and chamomile tea at the two different levels (2.5mg and 5mg) induced significantly (p≤0.05)lower in serum activity of uric acid, urea and creatinine, compared with those of untreated obese rats and treated obese rats with avocado juice. So the best result was recorded for obese rats treated with mixture of avocado juice and chamomile tea in a dose of 5mg. In agreement with these finding, Etab and Fatimah(2017) reported that diet fortified at 15% and 25% avocado can reduced kidney function. Fatemeh et al. (2018); Najla et al. (2012); Anthony et al. (2017) and Elbessoumy and Mahmoud (2013) reported that consumption of antioxidant activity of chamomile isone of the most important treatment strategies to cause reduction in serum creatinine. Also, Ellyet et al. (2019) showed that alkaloids, flavonoids and polyphenol at avocado, which can increase the glomerulus filtration, rate, and inhibit the increase of urea and creatinine.

Table (5): Effect of avocado juice and chamomile tea on kidney function of obese rats

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Groups</th>
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<th>(2) Control (+ve)</th>
<th>(3) 2.5 mg avocado juice</th>
<th>(4) 5mg avocado juice</th>
<th>(5) 2.5 mg avocado juice and chamomile</th>
<th>(6) 5 mg Avocado juice and chamomile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uric acid (mg/dl)</td>
<td>1.46±0.07^a</td>
<td>4.33±0.05^a</td>
<td>3.90±0.89^b</td>
<td>3.30±1.5^c</td>
<td>3.78±2.01^b</td>
<td>2.76±0.81^d</td>
<td></td>
</tr>
<tr>
<td>Urea (mg/dl)</td>
<td>34±2.83^d</td>
<td>89.30±3.54^a</td>
<td>86.3±4.04^b</td>
<td>70.34±2.5^c</td>
<td>78.0±3.01^b</td>
<td>68.4±2.47^c</td>
<td></td>
</tr>
<tr>
<td>Creatinine(mg/dl)</td>
<td>0.26±0.06^a</td>
<td>1.03±0.025^b</td>
<td>0.70±0.01^b</td>
<td>0.57±0.036^c</td>
<td>0.65±0.04^c</td>
<td>0.48±0.08^d</td>
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</tbody>
</table>

- All values represented as mean±SD.
- Means with different superscript letters in the same column are significantly different at (p≤0.05)
References


التأثير المحتمل لعصير الأفوكادو وشاي البابونج على الفئران المصاببة بالسمنة

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الملخص العربي

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الكلمات الافتتاحية: الأفوكادو، البابونج، دهون الدم، هرمونات الغدة الدرقية، وظائف الكبد، وظائف الكلى، السمنة.