Effect of Coffee Daily Consumption on Uric Acid Level and Body Weight to Prevent Metabolic Syndrome

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Abstract

Obesity was one of diagnosis criteria of metabolic syndrome. There was increasing mortality case of obesity in recent decade. High uric acid level was the early marker of metabolic syndrome. Coffee was one of favorite drink of obese and non-obese people in the world. Thus we investigated the effects of coffee drinking for preventing metabolic syndrome. This study was conducted by true experimental with randomized controlled group pretest-posttest design. Twenty four male wistar rats (10 weeks) were fed a standar density diet with and without 0.72 ml coffee solution daily during 14 days. Treatment and control group were greatest difference in the last day (day-14) or after study (t=-2.24; p<0.05). The difference in body weight decrease was bigger in treatment group. The difference in body weight increase became bigger with longer time in control group. Mean of body weight difference during 14 days, differed significantly (t=-4.59; p=0.00) between treatment (n=12) and control group (n=12). Mean of obese uric acid level at the start of study was higher than obese uric acid level at the end of study although the difference was not significant (p>0.05). Drinking 0.72 ml (equal with 2 cup of coffee in human) coffee daily during 14 days decreased uric acid level in obese rats model although not significant. Coffee has activity as antiobesity and has preventive action against metabolic syndrome disease.

Keywords: Coffee; Obese model rats; Non obese; Uric acid; Body weight; Metabolic syndrome

Introduction

Obesity is still one of the health problems in the world. Prevalence of metabolic syndrome increased in adult males aged> 45 years and in adult females aged >55 years [1]. Obesity is related with the body's immune response. Accumulation of adipose tissue influence inflammation response so increase body's immune response. Body's immune response is a response from the body's biological systemic structure which protect the body to combat diseases. This system must be able to detect various disease agents such as viruses to parasites (worms) and know how to differ this from organism that possesses healthy tissue [2,3]. Decreasing of body weight is characterized by reduced white adipose tissue as the main source of xanthin oxidase and decreasing of xanthin oksidase activity is the basic decrease of serum uric acid level [4]. High uric acid level is a marker of inflammatory response in metabolic syndrome [5,6].

Results study showed that minimal processing of diet that rich in whole foods such as vegetables, fruits, legumes (including coffee), grains, cereals would be able to slow glucose absorption [7]. The advantage of robusta coffee was could grow in tropical area and the price was not too expensive [8].

The total content of fenolic acid in hot water mixture of pure robusta coffee powder according to the previous study was 45.63 - 47.95 mg/g coffee powder or 456 mg/10 g - 479 mg/10 g robusta coffee powder which was higher than arabica coffee powder (342.3-396.3 mg/10 g) [9]. Previous study showed a decrease of 15% blood uric acid level on hyperuricemia wistar rats after consuming 0.72 ml of coffee solution during 7 days [10].

Results of surveillance on bibliography had not found studies that examined uric acid level in obese and non-obese. This study has chosen on obesity wistar rat model to find out the difference in effects of coffee given in condition of accumulated adipose tissue (pro-inflamatory rats) and without accumulation of adipose tissue. Is there any difference in uric acid level between obese Wistar rats group and non-obese that were given coffee drinking? The novelty of this study was based on bibliography surveillance that is study on measurement of various endogen antioxidant status i.e., uric acid had never been developed so far. The difference between this study and the previous study was that the study subject used obese rats model and non-obese rats.

The independent variable was giving robusta coffee powder that is equivalent with 2 cups per day which contained polyphenol and caffeine [10]. The dependent variables was uric acid level. The purpose of this study: to prove the difference of uric acid level of obese and non-obese rats between coffee drinking group (treatment group) and aqua drinking group (control group).

Methods and Materials

This study design is true experimental with randomized controlled group pretest-posttest design.

Population and samples

Study population: It was male Rattus Norvegicus of Wistar strain, ±10 weeks age. The blood samples were performed through retroorbitalis vein plexus.

Study samples: Size of minimal sample in experimental study referred to the WHO standard (1993). Requirement for experimental animal i.e., each treatment were at least 5 animal. It should be based on Federer rule→(k-1) (n-1)≥15. The size of sample in each group were at least 6 rats. Drop-out size was estimated 10% (d.o=0.1). Minimal size

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The obese rats used as subject in this study were obese rats as a result of food high in carbohydrate given to the mice [11-13] that was combined with standard food of more than 20 g/day (40 g/day). Experimental animals were maintained in separated cages, each experimental animal lived in 1 cage. We gave 0.72 ml coffee drink daily for 14 days to 6 obese treatment group and 6 non-obese treatment group. In addition, other study result showed that consumption of 2 cups per day was positively associated with higher plasma SHBG level (Serum Hormone Binding Globulin) and also associated with risk reduction of diabetes mellitus type 2 than consuming coffee less than 2 cups per day [14]. During the study, the entire rats in obese and non-obese group consumed the entire food available in each cage.

Coffee was the second most drink consumed in the world after water. Therefore, in this study rats were also given aqua water. Consumption of hygienic/aqua water that was made available in each cage was not consumed entirely by each experimental animal. Rats did not change into aggressive behavior during the study after consuming coffee. Rats could sleep well during study, both treatment and control rats. Consumption of coffee drink was given through sonde as much as 0.72 ml coffee solution and 2.28 ml warm clean water solution (3 ml in total). These coffee solution and 20 g standard food were given daily to obese treatment group and non-obese every morning for 14 days. Obese and non-obese control rats just consumed aqua water ad libitum and 20 g of standard food daily for 14 days. No rats died as a result of the treatment.

Wistar rats were adapted for 1 week. Then, underwent fattening for more than 1 month. Twenty four rats that full filled inclusion criteria as obese and non-obese study subject were were randomly separated into treatment and control group. Treatment group was the group that was given coffee drink of 0.72 ml/day for 14 days + standard food. Control group was the group that was given aqua water ad libitum for 14 days + standard food. Each experimental animal was placed in individual cage, where room temperature and illumination and comfort in cage always maintained for mice.

**Body weight characteristic during treatment**

In obese group, table showed statistically significant difference in mean difference of body weight between treatment group and control group in day-0 and day-14 after study (t =-3.19; p<0.05). Whereas non-obese group showed significant differences in mean body weight difference for every week between treatment and control group. Clinically, treatment group showed a decrease difference that was increasingly bigger. On the contrary the control group showed an increase difference that increasingly bigger with study time.

Table 1 said that the treatment group showed a decrease in mean body weight. The control group experienced an increase in body weight every week. The treatment group and control group were in greatest difference in the last day (day-14) after study (t=-2.24; p<0.05). The difference in body weight decrease was bigger in treatment group. The difference in body weight increase became bigger with study time in control group. Mean of body weight difference during 14 days, differed significantly (t=-4.59; p=0.00) between treatment group (n=12) and control group (n=12).

Body weight decrease occurred because coffee was a beverage with low glycemic index. This was supported by the fact that the amount of daily carbohydrate consumed did not influence BMI but the type of carbohydrate consumed [16,17] influenced BMI. Study result in several brands of packaged coffee powder showed that coffee was a type of grain that contained high carbohydrate [18]. The type of carbohydrate found in coffee was carbohydrate with low glycemic index [16,17].

### Table 1: Change in body weight per week (n=12).

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>BW 0-1</th>
<th>BW 1-2</th>
<th>BW 0-2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Treatment</td>
<td>12</td>
<td>-3.5 ± 9.43</td>
<td>-5.33 ± 10.58</td>
<td>-8.83 ± 16.6</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>9.0 ± 15.56</td>
<td>13.79 ± 16.46</td>
<td>22.79 ± 17.24</td>
</tr>
</tbody>
</table>

\[
(t/z, p) = -2.38 (0.02^*) \quad -3.38 (0.003^*) \quad -4.59 (0.00^*)
\]

**Explanation:**

- BW 0-1 = BW difference day 0 and day 7th
- BW 1-2 = BW difference day 1 and day 14th
- BW 0-2 = BW difference day 0 and day 14th

* Signifikant p<0.05; ¤ Independent t test; ¶ Mann Whitney test
Normal daily caffeine consumption was able to cause 3% increase in Total Energy Expenditure (TEE). Caffeine in coffee was like drugs such as amphetamine, ephedrine, and several antidepressants, it was able to stimulate sympathetic nerve system so increases body metabolism [19]. The potential of coffee had been studied in body weight reduction as thermogenic agent. Caffeine mechanism affects thermogenesis by inhibiting phosphodiesterase that stimulates degradation of intracellular cyclic AMP (cAMP) [20].

Uric acid level

Hyperuricemia is very strongly associated with obesity and metabolic syndrome and predict visceral obesity and insuline resistance. Hyperuricemia has a role in adipokine production. Uric acid that is soluble in water will directly stimulate redox of pro inflammation signal in adipose tissue [21]. Uric acid is one of endogen antioxidant. Nonenzymatic antioxidant that is a scavenger of free radical formed from purine degradation is exited to extra cellular fluid including the lung, blood and saliva [22]. Hyperuricemia induces endothelium dysfunction and cardiovascular disease [23].

Mean of uric acid level in all obese groups at the start of study was 2.40 ± 0.81. Mean of uric acid level in all non-obese groups at the start of study was 1.22 ± 0.63. Mann Whitney test between obese and non-obese group at the start of study showed significant difference (z=3.32; p<0.05).

Mean of uric acid level at the start of study in obese treatment group was 2.45 ± 0.91 and in obese control group was 2.33 ± 0.78. Mean of uric acid level in both obese group have normal distribution and there are no significant difference in the result of parametric non-paired differential test Independent t test (t=0.26, p>0.05). Mean of uric acid level at the start of study in non-obese treatment group was 1.10 ± 0.18 and in non-obese control group was 1.35 ± 0.5; the result of non-paired parametric differential test Independent t test did not show significant difference (t=-0.67, p>0.05).

Mean of uric acid level after 14 days of treatment in obese treatment group decreased -0.18 ± 1.11 to 2.09 ± 1.85 and also in control group there was a decrease of -0.80 ± 1.14 to 1.20 ± 0.57. Mean of uric acid level in non-obese treatment group experienced a decrease of -0.75 ± 1.38 to 1.10 ± 0.44 and control group also experienced a decrease of -0.23 ± 0.84 to 0.88 ± 0.40. Mean of uric acid in all obese and non-obese group experienced a decrease but it was not significant statistically (p>0.05) (Table 2).

In the Table 2 it appears that mean uric acid level in all treatment group (obese and non obese) at the start of study was 1.78 ± 0.95. Mean of uric acid level in all control group (obese and non obese) at the start of study was 1.84 ± 0.95 and there was abnormal data distribution, so the requirement for parametric non-paired differential test Independent t test was not fulfilled so we used alternative test with non-parametric Mann Whitney and the result was not significant difference (z=-0.23; p > 0.05).

Obesity increased uric acid level to become significantly different as compared with non-obese condition. Uric acid level in obese rats decreased more but was not significantly different after coffee was given as compared with non-obese group. Uric acid level in non-obese group decreased not significantly. This finding meant that coffee was able to decrease uric acid level if the value was above normal, although not significantly. If the uric acid level had been stable, then coffee consumption could not decrease uric acid level. Mean of uric acid level in all treatment groups experienced a decrease of -0.18 ± 1.11 from

### Table 2: Difference in body weight per week (n=12).

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>BW 0</th>
<th>BW 1</th>
<th>BW 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment 12</td>
<td>236.58 ± 51.02</td>
<td>233.1 ± 48.04</td>
<td>227.75 ± 45.6</td>
<td></td>
</tr>
<tr>
<td>Control 12</td>
<td>239.54 ± 38.49</td>
<td>248.5 ± 34.1</td>
<td>262.33 ± 27.75</td>
<td></td>
</tr>
</tbody>
</table>

Explaination:

- BW 0: body weight day 0
- BW 1: body weight day 7
- BW 2: body weight day 14

* Significant p<0.05; † Independent t test; § Mann Whitney test

In the Table 2 it shows that the treatment group showed a decrease in mean body weight. The control group experienced an increase in body weight every week. The treatment group and control group were in greatest difference in the last day (day-14) after study (t=-2.24; p<0.05). The difference in body weight decrease was bigger in treatment group. The difference in body weight increase became bigger with study time in control group. Mean of body weight difference during 14 days, differed significantly (t=-4.59; p<0.00) between treatment group (n=12) and control group (n=12).

The summary of result in Table 2 above showed that there were no significant difference in body weight, uric acid level in treatment and control group in the beginning of study (p>0.05), this meant that both treatment group and control group were in condition of no difference. But there was significant difference on body weight in treatment and control in the end of study (t=-2.24; p<0.05), also significant difference in all control group and treatment group (t=-4.26; p<0.05). This meant that at the start of study the body weight in the entire treatment and control group was not different, but coffee consumption was able to decrease body weight in treatment group because in all treatment group that consumed coffee had lower body weight (227.50 ± 45.89) compared with control group that only drank aqua water (262.33 ± 27.75).

Uric acid level at the start of study between control and treatment group (z=0.23; p>0.05) was not different significantly, but there was significant difference in uric acid level in control group between the start and the end of study (t=2.41; p<0.05). This meant that the consumption of aqua water was more able to decrease uric acid level so differed significantly than coffee consumption because there was no significant difference in uric acid level between the start and the end of study in treatment group that consuming coffee (z=-0.86; p>0.05) although the decrease of uric acid level also occurred in treatment group. In entirety, there was no significant difference between control and treatment group (t=1.33; p>0.5). This meant that coffee consumption was not different with aqua water consumption in influencing the difference of decrease in uric acid level, but aqua water consumption was better in influencing uric acid level decrease because the difference was significant as compared with consuming coffee that decreased uric acid level but the difference was not significant.

### Discussion

**Influence of coffee consumption on body weight of rats**

Body weight reduction is a way for individual with obesity to improve body composition with the purpose to increase immune response so reducing the risk of early mortality and the occurrence of chronic disease as a result of obesity. A person with obesity has
Table 3 on the result of differential test of uric acid showed uric acid level of treatment group was higher than control group (t=1.33; p>0.05). It meant that coffee consumption was not different with aqua water consumption in influencing the difference of decrease in uric acid level. Decrease of uric acid level occurred because coffee was a kind of drink with low glycemic index. This was supported by a statement that the amount of daily carbohydrate consumed did not affect BMI but the type of consumed carbohydrate [16,17] would affect BMI.

Uric acid level

Table 3: Summary of body weight and uric acid level from group and treatment.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group</th>
<th>N</th>
<th>Mean ± SD</th>
<th>Differential test all treatment and control t/z (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Weight</td>
<td>Treatment</td>
<td>12</td>
<td>236.58 ± 5 1.02</td>
<td>227.50 ± 45.89</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>12</td>
<td>239.54 ± 38.49</td>
<td>262.33 ± 27.75</td>
</tr>
<tr>
<td>Uric Acid</td>
<td>Treatment</td>
<td>12</td>
<td>1.76 ± 0.95</td>
<td>1.80 ± 1.38</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>12</td>
<td>1.84 ± 0.95</td>
<td>1.04 ± 0.50</td>
</tr>
</tbody>
</table>

Explanation: * Significant: p<0.05; † Paired t-test; ‡ Wilcoxon test; * Mann Whitney test

The summary of result in Table 3 above showed that there were no significant difference in body weight, uric acid level in treatment and control group in the beginning of study (p>0.05). It means that both treatment group and control group were in condition of no difference. There was significant difference on body weight in treatment and control in the end of study (t=2.24; p<0.05)**, also significant difference in all control group and treatment group (t=4.26; p<0.05)**. It means that at the start of study the body weight in the entire treatment and control group was not different, but coffee consumption was able to decrease body weight in treatment group because in all treatment group that consumed coffee had lower body weight (227.50 ± 45.89) compared with control group that only drank clean water (262.33 ± 27.75). Uric acid level at the start of study between control and treatment group (z=-0.23; p>0.05) was not different significantly, but there was significant difference in uric acid level in control group between the start and the end of study (t=2.41; p<0.05)**. It means that consumption of aqua water was more able to decrease uric acid level so differed significantly than coffee consumption because there was no significant difference in uric acid level between the start and the end of study in treatment group that consuming coffee (z=0.86; p>0.05) although the decrease of uric acid level also occurred in treatment group. In entirety, there was no significant difference between control and treatment group (t=1.33; p>0.05). It means that coffee consumption was not different with aqua water consumption in influencing the difference of decrease in uric acid level. Aqua water consumption was better in influencing uric acid level decrease because the difference was significant as compared with consuming coffee that decreased uric acid level but the difference was not significant.

Table 3: Summary of body weight and uric acid level from group and treatment.
the equivalent of 2 cups per day in human did not give side-effect in the form of sleep disorder in experimental animal moreover if it was not consumed before sleep time and continued consuming clean water. Therefore in this study, the researcher did not make comparison with standard drugs and only made comparison with clean water consumption.

The advantage of this study in comparison with other study were (1) True experimental study design. (2) Obese rats were compared with non-obese rats. (3) This study analyzed parameter based on treatment group that was given coffee drink and control group that was only given clean water and standard diet. Experimental animal with obesity was chosen because there was accumulation of adipose tissue. Excessive accumulation of adipose tissue would affect inflammation response. Therefore, we needed to know the difference in inflammation response between excessive and not excessive accumulation of adipose tissue. (4) Dose of 0.72 ml/day was equivalent with 2 cups per day in human and this was found from previous study. (5) Duration of study i.e., 14 days was chosen because the result of study from previous researcher showed that consuming 0.72 ml of coffee for 7 days was able to decrease uric acid level 15% in mice with hyperuricemia. This was the advantage and the difference of this study with the previous study.

**Influence of coffee drink on uric acid level**

The result of this study showed decrease of uric acid level in obese mice although not significant statistically (p>0.05). Previous study observed that coffee consumption was proved as having protective effect against hyperuricemia [29]. Previous study also showed result that coffee consumption of 0.72 ml per day for 7 days was able to decrease uric acid level as much as 15% in mice with hyperuricemia [10].

**Conclusion**

Drinking 0.72 ml coffee daily (equal with 2 cup of coffee in human) for 14 days could decreased uric acid level in obese rats model although not significant. Coffee has beneficial effects as antiobesity. Coffee has prevention action against metabolic syndrome disease.

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