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Effect of Sarang Semut (Myrmecodia pendans) Herbal Drink with Cinnamon Powder Against Blood Glucose in Sprague Dawley Rats with Type 2 Diabetes Mellitus

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Abstract

This research is a true experimental study with the design of randomized controlled group with pre-posttest design. The rats were divided into 5 groups (five rats each group): K (-), P1 sarang semut 5.4 mg-cinnamon 0 mg, P2 sarang semut 4.05 mg-cinnamon powder 3.6 mg. P3 sarang semut 2.7 mg-cinnamon powder 7.2 mg and P4 sarang semut 1.35 mg-cinnamon powder 10.8 mg for 21 days. The blood glucose level was measured using glucometer with the GOD-PAP method. The results were analyzed using One Way ANOVA followed by Post hoc Duncan to determine the average difference in blood glucose among the treatment groups. Sarang semut (Myrmecodia sp) herbal drink with cinnamon powder has a significant effect on decreasing blood glucose level before and after the treatment ($p = 0.000$). The best formula for lowering blood glucose was P1 (sarang semut 5.4 mg-cinnamon 0 mg). Sarang Semut herbal drink with cinnamon powder can decrease the blood glucose levels.

Keyword: blood glucose levels, cinnamon, diabetes, sarang semut

Abstrak

Penelitian ini merupakan penelitian true eksperimental dengan rancangan randomized controlled group dengan *pre-post test* design. Tikus dibagi menjadi 5 kelompok dengan lima ekor/kelompok: K (-), P1 sarang semut 5,4 mg-kayu manis 0 mg, P2 sarang semut 4,05 mg-kayu manis bubuk 3,6 mg, P3 minuman herbal sarang semut 2,7 mg-kayu manis bubuk 7,2 mg dan P4 sarang semut 1,35 mg-kayu manis bubuk 10,8 mg selama 21 hari. Glukosa darah diukur menggunakan glukometer dengan metode GOD-PAP. Hasilnya dianalisis menggunakan One Way ANOVA dengan Post hoc Duncan untuk mengetahui perbedaan rerata penurunan glukosa darah antara kelompok perlakuan. Minuman herbal Sarang semut (Myrmecodia sp) dengan bubuk kayu manis memiliki efek signifikan terhadap penurunan glukosa darah sebelum dan sesudah perawatan ($p=0,000$). Formula terbaik untuk menurunkan glukosa darah adalah minuman herbal sarang semut 100% (5,4 mg) dan bubuk kayu manis 0%. Minuman herbal Sarang Semut dengan bubuk kayu manis dapat menurunkan kadar glukosa darah.

Kata kunci: diabetes, kadar glukosa darah, kayu manis, sarang semut

INTRODUCTION

Diabetes Mellitus (DM) is a degenerative and non-contagious disease where there is an increase in DM prevalence in developing countries (Suyono, 2014). Almatsier (2013) states that DM is an accumulation of symptoms in humans with increased levels of blood sugar or blood glucose caused by less insulin production. WHO predicts an increase in diabetes patients in Indonesia up to 21.3 million in 2030 (Pdpersi, 2014).

One that must be taken into account on their antioxidant abilities is sarang semut extract *(Myrmecodia pendens)* (Kurniawati & Sianturi, 2016). Sarang Semut plant is an adherent plant that live stick on the big tree. In Papua, the medicinal use of Sarang Semut for the treatment has already been known since a long time ago (Roslizawaty *et al.*, 2013). Moreover, sarang semut has a huge number of the chemical contents including flavonoids, tannins, polyphenols, tocopherols, and other minerals such as calcium, iron, phosphorus, sodium, potassium, zinc, and magnesium (Muhammad, 2011).

Another source of antioxidants that can affect the blood glucose reduction is cinnamon. Phytochemical compounds make cinnamon a potential antioxidant source (Ferry, 2013). Due to its antioxidant properties, cinnamon can overcome gout, high blood pressure, ulcers, hermia, asthma, mouth sores, difficult defecation and diabetes mellitus (Syarif, Suryotomo & Soeprapto, 2015). Cinnamon bark has a distinctive odor, widely used for various needs, such as food or cake flavoring (Abdurachman & Hadjib, 2011). Cinnamon smells and tastes sweet, so it can be made as a syrup, the spicy flavor could warm the body. Cinnamon stick can be used for various purposes such as materials, furniture, and also fuel (Ferry, 2013).

Briefly, sarang semut and cinnamon have the same potential as natural antidiabetic. This study aims to know the effect of sarang semut herbal drink with cinnamon on decreasing blood glucose level.

RESEARCH METHOD

Design, Place, and Time

This study was a true experimental design with a pre and post approach randomized controlled group. This study was conducted in Laboratory of Food and Nutrition, Center of Food and Nutrition Studies, Universitas Gadjah Mada, Yogyakarta. This was a month study, conducted from 9th December 2019 - 11st January 2020.

Instrument and Material

The tools needed include cage, analytical scales, measuring cups, beaker glasses, spoon, blender, knife, basin, sieve, sonde hull to enter the test sample orally,

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glucometer, analytical balance. Materials used include *Sprague-Dawley* rats, aquades as a control negative, the standard food of AD-II white rat, sarang semut, cinnamon, Streptozotocin (STZ), and Nicotinamide (NA).

Research Subject

The population of this study was basic white adult rats aged 10-12 weeks, weight of 250-300 grams, healthy and agile obtained from the Experimental Animal Laboratory of Universitas Gadjah Mada. As for exclusion criteria were deformed, dead, sick, and not agile rat. The study used basic white rats which were divided into 5 groups; a negative control group and 4 treatment groups.

Treatment of Animals Test

The white rats were adapted for 7 days before the treatment and only given standard feed and aquadest. All rats were fasted for 8 to 10 hours, then injected with STZ at a dose of 45 mg/BW and NA 110 mg/kg BW. The rat would became diabetic in 48 hours post induction with blood sugar level >200 mg/dl. The K(-) group was given the aquadest as a negative control, P1 was given therapy with sarang semut herbal drink 5.4 mg-cinnamon powder 0 mg, P2 were treated with sarang semut herbal drink 4.05 mg-cinnamon powder 3.6 mg, P3 were treated with sarang semut herbal drinks 2.7 mg-cinnamon powder 7.2 mg, and P4 were given therapeutic sarang semut herbal drinks 1.35 mg-cinnamon powder 10.8 mg. The herbal drink was given to rat for 21 days treatment every morning. An examination of blood glucose levels was carried out on days 0, 7, 14 and 21 for each group.

Data Analysis

The data collected was primary data taken in a direct way measurements made by researchers. Data was tested with a computer application. Tests used include the normality test using Shapiro-Wilk continued by One Way Anova test to see the effect of the herbal drinks on the blood glucose level. The data were then analyzed using Post Hoc Duncan test to determine the average difference among the treatment groups. Other collected data were body weight of rats measured every week during the study. This study has received ethical permission from the Faculty Ethics Commission Medicine, Muhammadiyah Surakarta University with number: 2469 / A.1 / KEPK- FKUMS / XI / 2019.

RESULT AND DISCUSSION

Blood Glucose Before and After the Treatment

Measurement of blood glucose levels was carried out 4 times for each group: on the day after STZ and NA were induced as W0, on the 7th day as W1, on the 14th day as W2, and on the 21st day as W3.

Table 1. Blood glucose before and after the treatment

Group	Blood Glucose Levels (mg/dl ± SD)				*p**
	W0	W1	W2	W3	
K(-)	263 ± 7.07[a]	265 ± 7.51[b]	270.8 ± 6.76[d]	275.5 ± 5.43[e]	0.828
P1	261 ± 4.67[a]	247 ± 3.07[a]	137.8 ± 2.78[a]	109.1 ± 2.85[a]	0.000
P2	261 ± 3.60[a]	246 ± 1.96[a]	145.6 ± 1.86[b]	125.5 ± 1.76[b]	0.000
P3	262 ± 4.08[a]	248 ± 2.44[a]	156.3 ± 2.16[c]	138.1 ± 2.78[c]	0.000
P4	259 ± 2.78[a]	246 ± 3.07[a]	158.5 ± 2.42[c]	146.6 ± 2.94[d]	0.000

K- : Negative Control, P1: sarang semut herbal drink 5.4 mg / 200g BB, P2: sarang semut herbal drink 4.05 mg and cinnamon powder 3.6 mg, P3: sarang semut herbal drink 2.7 mg and powder cinnamon 7.2 mg, P4: A sarang semut herbal drink 1.35 mg and cinnamon powder 10.8 mg
W 0: Measurement after STZ and NA induction, W1: Measurement of 7th day after intervention, W2: Measurement of the 14th day after the intervention, W3: Measurement of the 21st day after the intervention
P *: One Way ANOVA,
W0 : (a) no significant different,
W1 : (a) no significant different, (b) significant
W2 : (a & b) significant different, (c) no significant different
W4 : (a – e) significant different

We used One Way ANOVA analysis to find out overall average difference among the groups, of which normality was previously being tested using Shapiro-Wilkl ($p>0.05$). The One Way ANOVA showed $p= 0,000$ ($p<0.05$) and it is concluded that sarang semut herbal drinks and cinnamon powder had a significant effect on blood glucose levels on 21st days of intervention. Furthermore, using Post Hoc Duncan, there were real differences between P1, P2, P3, and P4. Diabetic rats treated with P1 were more effective at reducing glucose blood levels.

The result of the blood glucose measurements showed on Table 1 are illustrated in the Figure 1. This graph presents the average rat blood glucose levels after STZ and NA induction and after the treatment of herbal drink.

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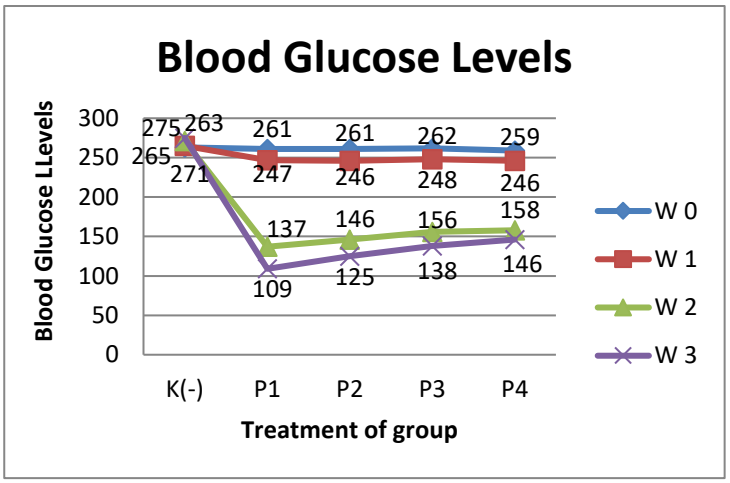

Figure 1. Blood glucose levels before and after treatment

Figure 1 explained the difference in average blood glucose levels on four measurements. W0 measurement showed the average value of blood glucose levels after STZ and NA induction. The measurement of W1 showed the results of the measurements after the intervention for 7th days but there was no significant difference among all the groups. In W2 and W3, the results of measurements were mixed. The average blood glucose level of rats in the negative control group was relatively high and was still in the range of hyperglycemia. As for P1, P2, P3 and P4, the results showed a significant decrease and differences in blood glucose levels in each treatment.

Average fasting blood glucose level in rats after STZ and NA induction was 262.04 mg/dl within 3rd days post induction. According to WHO, diabetic patient has fasting blood glucose level ≥200 mg/dl (Hasibuan *et al.*, 2016). The mechanism of STZ in raising blood glucose levels was as follows, STZ enters pancreatic ß cells through GLUT 2 causing the decreased expression of GLUT 2. GLUT 2 has properties that can bring glucose into cells indefinitely. This resulted in decreasing sensitivity of peripheral insulin receptors, so as to have an impact on improving insulin resistance and increasing blood glucose levels (Firdaus *et al.*, 2016).

The effect of reducing blood glucose levels in rats was caused by the antioxidant role of flavonoids, tannins and saponins in the ward against free radicals (Mardany, Chrystomo & Karim, 2016). In addition, the content of flavonoids contained in the herbal drinks can be used as antidiabetic therapy (Kurniawaty & Sianturi, 2016). The flavonoids content in sarang semut obtained as much as 26.84 mg/L (Indra, Supriadi & Ijriana, 2019).

Therapy used herbal drink of sarang semut and powdered cinnamon that allegedly has hypoglycemic mechanisms through the inactivation of free radical peroxide was able to attack the pancreas ß cells. Thus, the pancreas ß cells can release good insulin (Dheer & Bhatnagar, 2010). Another mechanism of flavonoids that

demonstrate hypoglycemic effect was to reduce the absorption of glucose and regulate the activity of the enzyme expression involved in carbohydrate metabolism (Brahmachari, 2011). This antioxidant activity can reduce oxidative stress thereby reducing ROS *(Reactive Oxygen Species).* In the formation of ROS, oxygen will bind the free electrons that come out due to the leakage of electron chains. The reaction between oxygen and free electrons produces ROS in the mitochondria (Annisa, Viryawan & Santoso, 2014).

Flavonoids were protective against ß cell damage as a producer of insulin and can increase insulin sensitivity (Panjuantiningrum, 2010). Antioxidants can suppress apoptosis of beta cells without changing the proliferation of pancreatic beta cells (Trisatya, 2015). Antioxidants can reduce Reactive Oxygen Species (ROS). In the formation of ROS, oxygen will bind to the free electrons that come out because of the leakage of the electron chain. The reaction between oxygen and free electrons was what produces ROS in the mitochondria (Annisa, Viryawan & Santoso, 2014). Antioxidants in flavonoids can donate hydrogen atoms. Flavonoids will be oxidized and bind to free radicals so that free radicals become more stable compounds (Panjuantiningrum, 2010).

Al-Dhubiab (2012) mentions that the biggest chemical components in cinnamon were cinnamon alcohol, coumarin, cinnamic acid, cinnamaldehyde, anthocinin and essential oils containing sugar, protein, simple fat, pectin and others. Ervina *et al.,* (2016) (Ervina *et al.,* 2016) stated that the extraction results of *Cinnamomum burmanii* bark contain the main antioxidant compounds in the form of polyphenols (tannins, flavonoids) and phenol group essential oils.

Ping *et al.,* (2010) indicates that the active ingredient in cinnamon, called cinnamaldehyde, can reduce plasma glucose levels in diabetic rats. Wardatun *et al.* (2017) found out of 100 grams of dried C.burmannii cinnamon bark extracted with ethanol maceration technique as much as 124.14 ± 1.17 mg/g. According to (Shen *et al.*, 2012), Cinnamaldehyde may increase glucose transport by GLUT 4 in adipose cells and skeletal muscles so that it can significantly reduce blood glucose. Zhu *et al.* (2017) states that from various research results proven sinnamaldehid shows the effect of reducing sugar in test animals through increased sugar release and improvement of insulin sensitivity in adipose tissue and muscle tissue, increase glycogen synthesis in the liver, improve pancreatic islet dysfunction, slow down gastric emptying time, improve gastric emptying time kidney failure due to diabetes and brain damage.

Other research have also stated that the presence of polyphenols in the *Cinnamon sp* extract may prevent the secretion of IR *(Insulin-Resistant),* and GLUT 4 in 3T3-L1 adipocytes, thereby reduced blood sugar levels (Jakhetia *et al.*, 2010). Polyphenol compounds were antioxidants that inhibit the initiation process, and propagation of the oxidation process of free radical formation. Polyphenols were able

to inhibit oxidation reaction through a radical capture mechanism by donating one electron to an unpaired electron (Mariyam, 2013).

The Methylhidroxy Calcone Polymer (MHCP) compound was a flavonoid that has an insulin-like effect. MHCP in cinnamon acts like insulin which activates glycogen synthesis, increases glucose uptake, activates insulin receptor kinase and inhibits dephosphorylation of insulin receptors (Tjahjani, Fenny & Onggirawan, 2014). The work of MHCP, among others, was to increase the concentration of IRS-1, an insulin receptor that will activate the PI-3K pathway. Activation of the PI-3K pathway will cause an increase in the synthesis of lipids, proteins, glycogen by glycogen synthase, and stimulate cell proliferation. This mechanism was responsible for the process of glucose distribution into cells. PI-3K will then cause GLUT-4 contained in the cytosol to move to the cell membrane so that glucose can enter the cell and into the mitochondria to be converted into ATP. Another action of MHCP was by inhibiting the enzyme GSK-3b which functions to inhibit glycogen synthase and inhibit PTP-1 in charge of the process of dephosphorylation of insulin receptors (Gunawan & Suhendra, 2013).

CONCLUTION

There was a significant effect of cinnamon powder on sarang semut *(Myrmecodia sp)* herbal drink against the blood glucose before and after treatment. The best formula for decreasing of blood glucose was 100% (5,4 mg) and cinnamon powder 0% (P1). Further study on the administration of sarang semut herbal drink with the addition of sweeteners such as stevia leaves were recommended.

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