Effect of Tea Concocted from *Bawang Dayak* (Eleutherine Palmifolia) on Cholesterol of Type 2 Diabetes Mellitus: Pretest-Posttest Control Group Design

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ABSTRACT

Two major problems suffered by patients with type 2 Diabetes Mellitus (DM) are linked to insulin resistance and impaired insulin secretion. They often occur in patients aged above 30 years and obese patients. High blood glucose and other complications, including increased LDL, are some of the risks faced by people with type 2 diabetes mellitus. *Bawang dayak* has been used for generations to treat various diseases, including diabetes mellitus, because it inhibits alpha glucosidase enzyme. The aim of this study is to reveal the efficacy of *bawang dayak* tea in lowering the cholesterol levels of patients with type 2 DM. This study is a quasy-experimental research. It involved 50 patients who were divided into the intervention group and the control group. *Bawang dayak* tea was administered to the intervention group, twice a day in the morning during 4 weeks. Data analysis determined the differences in the control and intervention groups using the Mann Whitney test. The result of pre- and post-group was p value=.001 (<.05), meaning that there was a significant difference in median cholesterol levels, while the result difference of the two groups was p value=.002 (<.05), implying there was a significant difference in cholesterol levels of the two groups. *Bawang dayak* tea has been shown to lower cholesterol and have a potential as a non-pharmacological treatment in patients with type 2 DM.

Keywords: Bawang dayak tea, Cholesterol, Type 2 diabetes mellitus patients

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INTRODUCTION

Patients with type 2 diabetes mellitus (DM) experience two major problems, namely, sensitivity to insulin (insulin resistance) and impaired insulin secretion. These problems frequently occur in patients aged above 30 years and obese patients (Kahn et al., 2014). Furthermore, WHO estimates that the number of people living with diabetes in Indonesia will increase from 8.4 million in 2000 to approximately 21.3 million in 2030. It means the number will be double or triple by 2035 (WHO, 2017).

Insulin resistance in DM patients can cause glucose intolerance, triglyceride-rich very low-density lipoproteins (VLDL), decreased high density lipoproteins (HDL) level, and hypertension, which become independent risk factors for pathogenesis of atherosclerosis (Besseling et al., 2015). Bad cholesterol levels in DM patients, including elevated triglyceride level, low density lipoproteins (LDL) level, and decreased HDL levels, are the strongest risk factor for the atherosclerosis in DM patients (Temelkova et al., 2000). Moreover, cholesterol testing is very important for DM patients since hypercholesterolemia often occurs in DM patients, leading to cardiovascular disease. Hypercholesterolemia is characterized by an elevated triglyceride levels and decreased HDL levels, while LDL levels tend to be normal or slightly elevated (Besseling et al., 2015).

The efficacy and safety of medicinal plants in Indonesia has been recognized merely based on empirical experiences and inherited from generation to generation instead of being scientifically tested. For this reason, studies on traditional medicine are required, particularly to verify its safety and efficacy. Plant extracts and phytochemicals that are often implicated as having anti-diabetic effect can be investigated as the basis for the discovery of phytopharmaceutical drugs for patients with DM (Setyawan et al., 2016). Moreover, eighty percent of people in developing countries claim to use traditional medicine derived from medicinal plants (Fajarini et al., 2016).

Bawang dayak (*Eleutherine palmifolia*) is an endemic plant of Kalimantan. It has green leaves with white flowers and red bulb that resembles an onion. *Bawang dayak* is traditionally boiled in water or extracted and it is believed to be effective as a medicine for breast cancer, hypertension, diabetes mellitus, cholesterol, and ulcers (Ahmad et al., 2016).

Antioxidant activity and alpha glucosidase inhibitors in the ethanol extract of *bawang dayak* bulbs are greater than those in its water extracts. Phytochemical screening and calculation of total flavonoids and total phenols also showed that the types and content of phytochemical compounds in ethanol extracts are higher than those in water extracts. Antioxidant activity and inhibitory ability of alpha glucosidase enzymes in *bawang dayak* bulbs form a potential and useful anti-diabetic agent in prevention and protection (prophylaxis) against DM (Kuntorini et al., 2016).

Process of making *bawang dayak* extract begins with choosing a good and fresh *bawang dayak* which is indicated red bulbs, single leaf and roots having brown colour. Then, *bawang dayak* is washed in the running water until it is

clean. After that *bawang dayak* is cut bawang into slices and dried in the sun for 3 days. After it is dry, 3 teaspoons of

bawang dayak slices in 250 ml of hot water until the water changes colour to red (Figure 1).

Choose a good bawang dayak, it is indicated with red bulbs, single leaf and has brown roots colour

Wash the bawang dayak in the running water until it is clean.

Then cut Bawang dayak into slices and dry it in the sun for 3 days

Cut the roots and leaves but let the inside of bawang dayak remains

After it is dry, add 3 teaspoons of bawang dayak slices in 250 ml of hot water. The Bawang dayak tea is ready.

Figure 1: The process of make bawang Dayak tea (Galingging, 2009)

MATERIALS AND METHODS

This research is a quantitative study with a quasy-experiment research design and a pretest-posttest control group design approach. A multistage sampling was used to

select type 2 diabetes mellitus patients for this study. First, patients were selected from Juanda Public Health Center Samarinda using purposive sampling technique. Information about the recruitment of the patients was

distributed using a flyer sent by the public health center to health cadres in their working area. A total of 80 patients aged 30-65 years were initially identified for the study. The main inclusion criterion of patients for the study was patients aged 30 to 65 years living in the area of Juanda Public Health Center, Samarinda, agreeing to participate in the study from beginning to end, and suffering from type 2 DM with blood sugar 200-400mg/dl, Meanwhile exclusion criterion for the study was patients who received insulin injection therapy and had severe disease complications such as kidney failure or heart disease.

Based on inclusion and exclusion criteria, 20 patients were excluded from the study (not meeting inclusion and exclusion criteria=12; declining to participate =5; and other reason =3). A total of 60 type 2 diabetes mellitus patients participated in this study. The 60 patients were randomly allocated in two group, randomized by computer-generated number. The two groups were intervention group (30 patients) and control group (30 patients). During the intervention program, five patients were dropped from the intervention group (lost to follow-up/moved other cities =3; discontinued intervention/ limited time =2), while five patients were dropped in control group (lost to follow-up =4; discontinued intervention/sick =1). At the end of study, data of 10 patients were excluded from analysis, including five in the intervention group (due to missing data) and five in the control group (due to loss to follow-up), respectively. Data from a total of type 2 diabetes mellitus patients divided into two groups (25 of patients in intervention group and 25 of patients in control group) were used and analyzed in this study (figure 2).
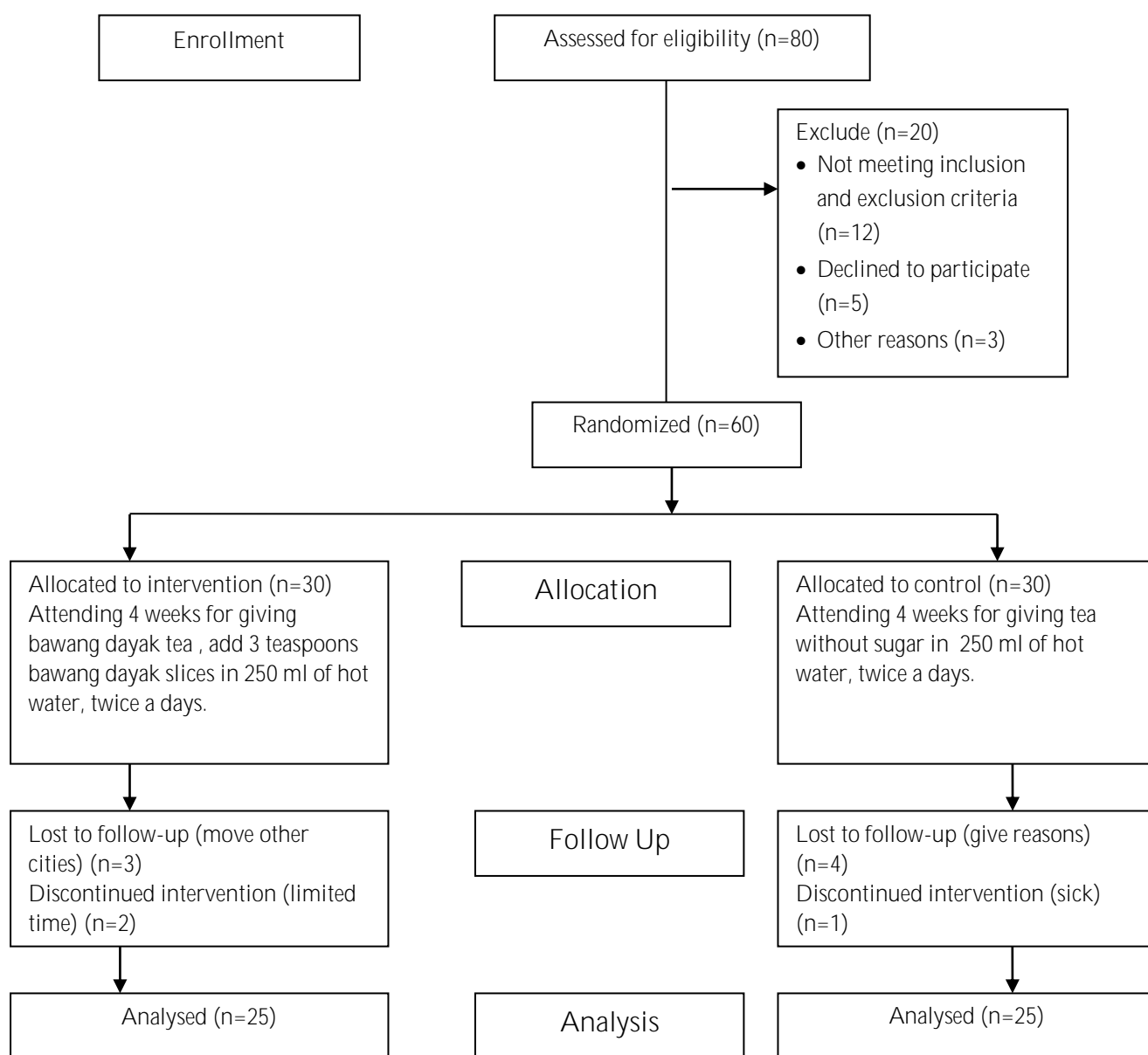

Figure 2: CONSORT flow diagram for enrollment, allocation and follow up participants

This research was conducted at Public Health Center of the Juanda district, Samarinda from June-July, 2018 . The Juanda Public Healt Center was chosen based on the consideration that the number of DM patients there has

doubled from 2014 to 2016. Moreover, in Samarinda City, Juanda Public Health Center is included in the top 10 with the highest number of client visits.

In this study, bivariate analysis used the paired t-test to assess the difference in the means of two study groups and Mann Whitney test to compare differences between the control group and the intervention group. Cholesterol testing was done using calibrated digital meter. Furthermore, this study has been approved by the Health Research Ethics Committee of East Kalimantan Health Polytechnic with the Ethical Clearance No: LB. 02.01/7.1/5071/2018.

RESULTS

1. Characteristics of Respondents

Table 1: Distribution of Respondents and Characteristics

Characteristics	Frequency	Percentage
1. Age		
40-54 years	10	20
55-64 years	33	66
>65 years	7	14
2. Gender		
Male	19	38
Female	31	62
3. Smoking status		
Smoker	37	74
Non-smoker	13	26
Total	50	100

Source: Primary data (2018).

Table 1 tittled analysis of the distribution of respondents based on their characteristics shows the dominant age of respondents (33 people or 66%) was 55-64 years. Based on gender, 31 respondents (62%) were female while based on smoking status, 37 respondents (74%) were smoker.

2. Changes in Mean Cholesterol Levels

Table 2: shows the results of changes in mean cholesterol levels of both control group and intervention group in the pre- and post treatment.

Group	Pre-Post	(Mean±SD)	95% CI	t	ρ *
Control	235.5-217.1	28.300±8.042	22.546; 34.053	11.128	.001
Intervention	207.2-174.4	42.700±28.273	22.475; 62.925	4.776	.001

Source: Primary data (2018)
*p<0.05 Paired t-test

Table 2 demonstrates the result of the paired t-test, in which there was a significant difference in mean cholesterol levels of the intervention group with p value of .001 or less than the significance level (p<.05). Decreased mean cholesterol levels of the intervention group are marked by t ratio (t=4.776), which is less than the control group with t ratio (t=11.128).

3. Differences between The Changes in Cholesterol Levels of Control Group and Intervention Group

Table 3: is the differences between the changes in cholesterol levels of respondents in control group and intervention group.

Respondent	N	Variable	Mean	Z	P*
Control	25	Cholesterol	14.50	-3.029	.002
Intervention	25		6.50		

Source: Primary data (2018).
*p<0.05 *Mann Whitney*

Table 3 shows the significant difference in the mean cholesterol levels between the intervention group and the control group as indicated by the results of Mann Whitney test with a significance value of .002 (p<.05). The significance value means that there was a significant difference in cholesterol levels between the control group and the intervention group after treatment of *bawang dayak* tea. Subsequently, the mean cholesterol levels of the control group and the intervention group were 14.50 and 6.50, respectively, meaning that there was a significant difference between those groups.
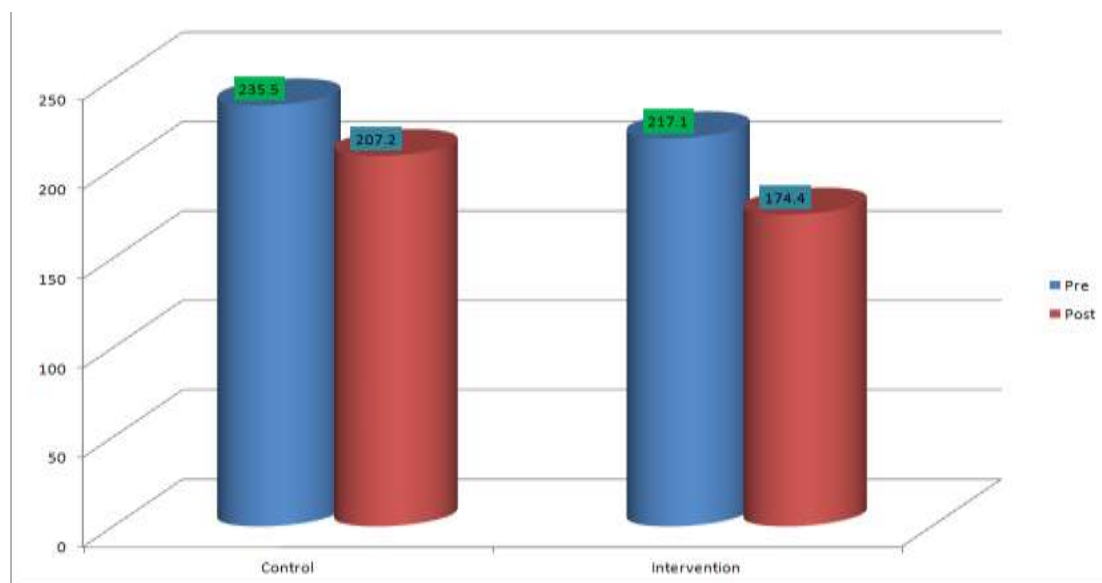
Figure 3: Differences in mean cholesterol levels of control group and intervention group in the pre and post treatment

DISCUSSION

The results of the present study of Characteristics of respondents in Table 1 show that 66% of the respondents aged 55-64 years. It verified the risk for the development of type 2 DM that increases with age, particularly the age of 40 years and over. Al-Saeed et al,.(2016) claimed that patients with type 2 DM belong to the same age group, which is 40-65 years or middle adulthood period.

The factor of age influences the health condition of an individual since the working mechanism ability of the organs of one's body, including the abilities of absorption, synthesis and fat excretion will decrease. Aging affects the function of the body's organs, in which harmful chemicals, including cholesterol that accompanies the activities of the body's organs, are accumulated in the body. Cholesterol levels can elevate with increasing age. Hirst (2013) argued that the older a person got the lower the ability of LDL receptor activity became and the higher the LDL cholesterol level.

The present study confirmed the theory that aging caused humans to experience a physiological change that decreases rapidly after the age of 40 years. It becomes a factor in the occurrence of type 2 DM. Holaman et al.,(2008) asserted that the physiological change affected the decrease in pancreatic endocrine function to produce insulin.

Furthermore, the majority of respondents in the present study Table 1 were female, with a total of 31 people (62%). The result of this study verified the theory that type 2 DM is more common in females than in males. Women have higher LDL triglyceride levels compared to men. Mesalic et al.,(2008) reaffirmed that despite the fact that women have lower total cholesterol levels than men of the same age, they tended to have higher LDL cholesterol levels after menopause. Fritschi et al.,(2012) also claimed that the increase in blood lipid levels of women was higher than than of men. The body fat ranges between 15-20% of body mass in men and 20-25% in women and hence, the risk for DM in women is 3-7 times, higher than in men (of 2-3 times).

As it is shown in Tabel 1 the present study also found in that most respondents were smokers with a total of 37 people (74%). Meanwhile, according to Chidozie et al.,(2014), smoking habits can lower HDL levels in the bloodstream and blood will easily clot. Thus it increased the risk for clogged arteries, heart attack,and stroke.

Furthermore, Chang.,(2012) declared that smoking 20 or more cigarettes per day could result in a decrease in HDL level of approximately 11% for men and 14% for women. This habit can cause blockage (thrombosis) in a narrowed coronary artery. Moreover, it is proven to increase LDL levels in the blood and reduce HDL levels.

The Framingham Heart Study has examined men and women in the age of 20-49 years, and reported that HDL cholesterol levels were 4.5 to 6.5% lower in smokers. Nevertheless, the results showed that none of the respondents were smokers, and in the absence of smoker respondents, one of the factors that can affect the lipid profile and worsen the condition of patients with type 2 DM could be evaded since smoking can increase LDL levels and lower HDL levels. Moreover, Mahmood et al.,(2014) reaffirmed that cholesterol levels that were not controlled properly over a period of time would lead to serious complications in patients with type 2 DM.

The analysis in table 2 shows the results of changes in mean cholesterol levels of both control group and intervention group in the pre- and post treatment, and the result of the paired t-test, in which there was a significant difference in mean cholesterol levels of the intervention group with p value of .001 or less than the significance level (p<.05).

Additionally in table 3 and figure 3 that present the changes in cholesterol level in the present study, it can be seen that there was a significant difference in the mean cholesterol levels between the intervention group and the control group as indicated by the results of Mann Whitney test (a significance value=.002 (p<.05). It means that there was a significant difference in the cholesterol levels between two groups after the treatment of *bawang dayak* tea.

Table 4: Phytochemical Content of Bawang Dayak

Test	Extract type	
	Water	Ethanol
Alkaloid	+++	++
Saponin	+	+
Tannin	+	++
Phenolic	++	+++
Flavonoid	-	+++
Triterpenoid	++++	++++

Source: Febrinda et al., (2013).

Desc, + = weak positive, ++ = positive, +++ = strong positive, ++++ = very strong positive.

The results of the present study in Table 4 confirmeds the research results of Febrinda et al.,(2013), that *bawang dayak* contains phenolics, triterpenoid and flavonoid, which are capable to lower cholesterol, particularly bad cholesterol or LDL levels, and serve as antioxidant. Similarly, this study is consistent with the results of previous qualitative and quantitative measurements, where the ethanol extract of *bawang dayak* bulbs had higher types of phytochemical compound as well as higher total phenolic and total flavonoids than its water extract does. In patients with DM, there is a condition where the production of Radical Oxygen Species is more intensive, leading to oxidative stress in the body (Kumar et al., 2012).

Oxidative stress is a condition where the oxidant or free radicals in the body is higher than antioxidants. Meanwhile, insulin deficiency in DM causes various disorders in the metabolic and regulatory processes that cause accumulation of fat, including total cholesterol. It occurs due to the lack of insulin that increases the mobilization of free fatty acids from adipose tissue and results in increased production of LDL-cholesterol (Latha & Daisy, 2011).

Moreover, Febrinda et al.,(2013) claimed in table 4 that *bawang dayak* bulbs were anti-diabetic agents that were useful in the prevention and protection of DM by serving as an alpha-glucosidase inhibitor. The result is also confirmed by the result of the present study.

Bawang dayak bulbs contain alkaloids, flavonoids, saponins, terpenoids, steroids, glycosides, tannins, phenolics, anthraquinones. Meanwhile, the chemical compounds found in the ethanol extract of *bawang dayak* bulbs are alkaloids, flavonoids, glycosides, saponins, anthraquinone glycosides, tannins and triterpenoids/steroids. The chemical compounds found in the ethyl acetate fraction are phenolics, tannins and flavonoids (Subramaniam et al, 2012). Moreover, flavonoid has a function in inhibiton of chronic inflammatory processes, particularly rheumatoid arthritis (Harfiani et al.,2016)

Alpha glucosidase inhibitor (AGI) is one of the antidiabetic agents that works by inhibiting alpha-glucosidase enzyme activity. Decreased absorption of carbohydrates from food by the intestine is a therapeutic approach for postpandrial hyperglycemia. The complex polysaccharide will be hydrolyzed by the amylase enzyme into dextrin and further hydrolyzed into glucose by the alpha-glucosidase enzyme before entering the blood circulation through absorption of

the epithelium. Amylase and synthetic alpha-glucosidase inhibitors (e.g., acarbose) have been extensively utilized for the treatment of patients with type II DM, yet they also reported to cause various side effects (Feng et al., 2011). Therefore, many attempts have been done to find AGI from natural sources to treat DM.

Glucosidase activity is substantial for various biochemical processes including degradation of polysaccharides to furnish monosaccharide units, which further can be absorbed and used by organisms. Therefore, in the condition of hyperglycemia in which the concentration of sugar in the high blood exceeds normal as in the case of diabetics, the inhibition of the alpha-glucosidase enzyme can be helpful since it reduces the amount of monosaccharide absorbed by the intestine.

DL oxidation is one of the main causes for atherosclerosis in humans, while the increased total cholesterol and LDL cholesterol in the blood are the main factors for coronary disease. Thus, antioxidants play a very significant role in preventing the complications in DM patients, particularly since cholesterol can build up in the arteries (Subramaniam et al., 2012).

It is expected that in the antioxide activity, there will be an increase in HDL cholesterol which can reduce plaque occurrence due to the atherosclerosis process so that complications of diabetes mellitus such as coronary heart disease and stroke, can be avoided.

CONCLUSSION
Bawang dayak tea is proven to lower cholesterol in patients with type 2 DM. It is confirmed by the difference in the mean cholesterol levels between the control group and the intervention group, in which the intervention group had lower levels. The efficacy of *bawang dayak* tea as a non-pharmacological effort to lower cholesterol in patients with type 2 DM should be disseminated.

CONFLICTS OF INTEREST
The author(s) have no conflict of interest to declare

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