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EFFECTIVENESS OF BREADFRUIT LEAF EXTRACT (*ARTOCARPUS ALTILIS*) IN IMPROVING METABOLIC SYNDROME (METS) COMPONENTS IN DIABETES MELLITUS PATIENTS IN BONE REGENCY - INDONESIA

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ABSTRACT

Metabolic Syndrome (MetS) is a significant public health issue in Indonesia. While previous studies have found the effectiveness of breadfruit leaf capsules in improving metabolic status among prediabetics, limited studies exist on their effectiveness in people with Diabetes Mellitus (DM). This study aimed to assess the effectiveness of breadfruit leaves extract in improving components of MetS in patients with Diabetes Mellitus. The study was conducted as a double blind Randomized Controlled Trial (RCT). A total of 46 participants were recruited through public announcements. The intervention group received breadfruit leaf capsules, while the control group received placebo. Measurements of blood glucose, high density lipoprotein (HDL), triglycerides, blood pressure, consumption patterns, and anthropometry were conducted both before the intervention (pre-treatment) and after the 21-day intervention period (post-treatment). Data analysis was performed using SPSS software, employing independent t-tests and paired t-tests. Statistical significance was defined as a p-value <0.05. Systolic and diastolic blood pressure in the control group and breadfruit leaf extract group were both significantly different in pre-treatment and post-treatment ($p<0.05$). But the decrease in the breadfruit leaf extract group was greater than in the control group, both in systolic blood pressure (15.43±2.57 mmHg vs 7.13±2.77 mmHg) and in diastolic blood pressure (5.00±2.27 mmHg vs 4.7±2.88 mmHg). Blood glucose levels in the control group and breadfruit leaf extract group were both significantly different in pre-treatment and post-treatment ($p<0.05$). But the decrease in the breadfruit leaf extract group was greater than in the control group (76.44±49.86 mg/dL vs 23.83±8.37 mg/dL). HDL cholesterol and triglycerides in the control group and breadfruit leaf extract group were both significantly different in pre-treatment and post-treatment ($p<0.05$). But the changes in the breadfruit leaf extract group were greater than in the control group (21.09±15.43 mg/dL vs 6.31±6.0 mg/dL), and triglyceride levels decreased more in the breadfruit leaf extract group than in the control group (57.74±35.72 mg/dL vs 22.6±11 mg/dL). Changes in metabolic syndrome components in DM sufferers were significant in both the breadfruit leaf extract group and the control group, but the changes in the intervention group were better when compared to the control group. Further research needs to be carried out with larger samples and a longer duration of intervention to confirm these results.

Key words: Artocarpus, blood, breadfruit, cholesterol, glucose, HDL, metabolic syndrome, prediabetics, triglycerides

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INTRODUCTION

Metabolic Syndrome (MetS) has become an increasingly urgent global public health concern. According to a report by the World Health Organization (WHO), the prevalence of MetS has steadily risen over the past few decades and now affects more than 20-25% of the global adult population [1]. MetS refers to a cluster of conditions, including insulin resistance, hypertension, dyslipidemia, and abdominal obesity, which significantly increase the risk of cardiovascular disease and type 2 diabetes mellitus (DM). This global surge is attributed to lifestyle changes, such as poor dietary habits, lack of physical activity, and rising rates of obesity.

A similar trend is observed in Indonesia, where MetS has emerged as one of the primary health concerns. According to the National Health Survey, the prevalence of MetS in Indonesia is estimated to be 21.66% among the adult population, with higher prevalence rates among individuals with obesity and DM [2]. This rising prevalence is closely linked to high-fat diets, excessive sugar consumption, and insufficient physical activity, particularly in urban areas. In Makassar (a large city), a study conducted on outpatients in the Public Health Center service area found that the prevalence of MetS was 71% [3]. Similarly, research on menopausal women in North Lampung reported a MetS prevalence of 46.3% [4]. A study conducted at the Palembang Health Center (an urban area) revealed a MetS prevalence of 59.3% [5]. Another study involving middle and high school teachers found a prevalence of 39.5% [6], while research on workers in Jakarta showed a prevalence of 38.7% [7].

MetS contributes to the development of various degenerative diseases. This can be explained by the mechanism of oxidative stress and redox imbalances occurring within cells. The increased production of oxidizing species in MetS leads to mitochondrial dysfunction, the accumulation of oxidation products, protein and lipid damage, and an imbalance in the antioxidant system [8]. MetS is closely associated with several parameters, including obesity, insulin resistance, diabetes, elevated triglycerides, and hypertension. Obesity is a major factor in the incidence of MetS, although the exact mechanism remains uncertain. Diabetes causes lipoprotein disorders, known as dyslipoproteinemia, and insulin resistance syndrome, elevated levels of free fatty acids stimulate triglyceride production and reduce HDL cholesterol [9].

Insulin resistance is a condition in which the body is unable to utilize insulin effectively. Hypertension is often linked to metabolic disorders such as obesity, glucose intolerance and dyslipidemia. Insulin resistance and hyperinsulinemia activate the sympathetic nervous system, which increases sodium reabsorption, heart rate, and vasoconstriction. ultimately leading to hypertension. Dyslipidemia, a disorder of lipid metabolism, is characterized by abnormal blood lipid levels,

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including elevated total cholesterol, low-density lipoprotein (LDL), and triglycerides, along with reduced levels of HDL [10].

Diabetes Mellitus (DM) is a major contributor to MetS. People with DM often experience insulin resistance, which exacerbates the conditions associated with MetS. The close relationship between DM and MetS is evident in the increased risk of cardiovascular complications and organ damage in patients with both conditions [11]. The pathophysiological mechanisms underlying MetS in DM patients involve insulin resistance, chronic inflammation, and lipid metabolism disorders. all of which worsen metabolic disruptions.

However, despite the availability of various therapies to manage MetS in DM patients, the effectiveness of these treatments remains limited. Pharmacological treatments such as metformin and statins can help improve certain components of MetS, but long-term treatment is often accompanied by side effects and limitations in addressing all components of the syndrome simultaneously [12]. Therefore, a more comprehensive and natural approach is needed in managing MetS in patients with DM.

Breadfruit leaves have been used in traditional medicine for centuries due to their rich chemical composition, which includes flavonoids, quercetin, saponins, polyphenols, tannins, and hydrocyanic acid [13]. Research indicates that breadfruit leaves possess significant pharmacological properties, making them a promising candidate for medicinal development [14, 15, 16, 17]. Empirical evidence supports the use of breadfruit leaves in treating various conditions, such as lowering blood sugar levels, and managing hepatitis, cardiovascular diseases, and skin disorders. The flavonoid compounds found in breadfruit leaves are particularly effective in inhibiting oxidative reactions, thereby reducing or neutralizing free radicals [18]. Additionally, breadfruit leaves have been reported to have no adverse effects on the body's organs [19]. In Nigeria, the antioxidant properties of methanolic extracts of breadfruit leaves were studied for their impact on kidney function. The findings revealed that the methanol extract of breadfruit leaves can mitigate damage to kidney histological structures caused by cadmium exposure [20].

Breadfruit leaves (*Artocarpus altilis*) have long been recognized in traditional medicine across various Asian countries for addressing a range of health issues, including metabolic disorders. Recent studies suggest that breadfruit leaf extracts possess strong anti-diabetic, anti-inflammatory, and antioxidant properties that may help improve metabolic conditions in patients with DM. The flavonoids and other active compounds found in breadfruit leaves can enhance insulin sensitivity, lower blood glucose levels, and improve lipid profiles [21]. Furthermore, the potential of

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breadfruit leaves to reduce systemic inflammation associated with MetS has been demonstrated in both in vivo and *in vitro* studies.

Insulin resistance has a strong association with obesity and other components of MetS. There is a strong link between insulin resistance and MetS. Therefore, control of insulin resistance is important in the prevention of the development of MetS. The aim of this study is to evaluate the effectiveness of breadfruit leaves in improving the components of MetS in patients with DM. This research is expected to provide new insights into the potential therapeutic use of breadfruit leaves in managing metabolic syndrome (MetS) in patients with diabetes mellitus (DM). By exploring the effects of breadfruit leaves, the study aims to contribute valuable findings that could enhance current treatment approaches for MetS in individuals with DM.

MATERIALS AND METHODS

Research Design

This study was a double-blind, randomized controlled trial (RCT) conducted at the Biru Public Health Center in Bone City, South Sulawesi, Indonesia. Participants were divided into two groups: the intervention group, which received breadfruit leaf extract capsules, and the control group, which received placebo capsules. Both groups also received standardized health education provided by the researchers. To randomize the participants, the researchers prepared papers labeled "Group A" and "Group B," which were rolled up, placed in a container, and shuffled. Participants who agreed to join the study were asked to select one of the coded papers and return it to the researchers, who then assigned them to the corresponding group.

Materials

The breadfruit leaf extract was produced by PT Fitomedika Indonesia (IFI) in Takalar. A total of 60 kg of breadfruit leaves were cleaned, air-dried, and finely chopped. The leaves were placed in a drying room with a cooling system set to 18°C for 72 hours. After drying, the leaves were ground into a fine powder (simplisia), yielding 9 kg of material. The simplisia was subjected to a maceration process by mixing it with 500 liters of reverse osmosis water at a ratio of 1:10 for 3 hours, with stirring every 28 minutes. The mixture was then processed in a spinner/separator at 2800 rpm for 10 minutes to separate the residue from the filtrate. The filtrate was freeze-dried using a HaiCuan-brand freeze dryer at -60°C (sublimation method) for 36 hours, producing 1000 grams of solid extract. The dried extract was weighed at 500 mg using a digital scale and encapsulated by the internal quality control team.

The intervention group received breadfruit leaf extract capsules, while the control group received placebo capsules. Both groups also received standardized health education, which focused on dietary management for diabetes mellitus (DM) patients. The educational materials, provided by the Ministry of Health, included

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leaflets, along with additional information on the benefits of breadfruit leaves developed by the researchers. The researchers explained the leaflet contents to the participants during a single educational session conducted prior to the administration of the capsules. The session lasted approximately 10 minutes per participant. To ensure compliance, daily monitoring of capsule consumption was carried out via a family member's mobile number. Additionally, door-to-door visits were conducted once a week to check participants' health and verify their control cards, which recorded capsule intake. Participants were considered compliant if they consumed at least 80% of the capsules provided, and all participants adhered to the prescribed capsule regimen.

Subjects

The sample size for this study was determined using the formula provided by Dahlan [22]. Based on these calculations, the required sample size for each group was 13 participants. To account for a potential 50% dropout rate, the minimum required sample size was adjusted to 20 participants per group. A total of 23 participants were recruited for each group, resulting in 46 participants overall. Study subjects were selected based on inclusion criteria, which included patients diagnosed with type 2 diabetes mellitus (DM-2) by a physician, having DM for less than four years, and agreeing to consume breadfruit leaf extract capsules for 21 days (3 weeks). Exclusion criteria included severe illness, such as being unable to participate in interviews, and pregnancy during the study period.

Subjects were classified as having Metabolic Syndrome (MetS) based on the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) criteria. Participants were diagnosed with MetS if they exhibited three out of five symptoms: hypertension (high blood pressure), dyslipidemia (low HDL levels), elevated triglyceride levels, high blood sugar levels, and central obesity.

Ethical Approval

This research was conducted with the approval of the Ethics Committee of the Faculty of Public Health, Hasanuddin University. Detailed information about the study was presented to the participants before the research began. Ethical approval for the study was granted by the Ethics Committee of the Faculty of Public Health, Hasanuddin University, Makassar, with approval number 4885/UN4.14.1/TP.01.02/2022, dated May 13, 2022. During the study, both researchers and participants adhered to health protocols to prevent the spread of COVID-19. Participants were informed of any potential risks associated with the study, as outlined in the research certificate and Informed Consent form, which also included an explanation of the study's purpose and benefits. The confidentiality of participants' data was ensured through the use of initials, unique codes, and respondent numbers. All data were used exclusively for research purposes.

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Data Collection

Measurements of blood sugar, HDL, triglycerides, blood pressure, dietary patterns, and anthropometry were taken before the intervention (pre-treatment) and after the 21-day intervention (post-treatment). Standardized tools were used to assess changes in weight and height, with digital scales for body weight and a stadiometer for height. Blood pressure was measured twice during the 21-day period at 10 a.m. using a manual sphygmomanometer by a general practitioner responsible for the study. Blood samples (3 cc) were collected from participants' veins before and after the intervention, stored at 2-6°C, and analyzed at Bintang Jaya Clinical Laboratory, Bone Regency, by trained laboratory staff.

Quality control was maintained throughout the study, ensuring that all research phases adhered to theoretical frameworks and scientific protocols. Measurement tools were calibrated for accuracy and reliability at the Biophysics Laboratory of the Faculty of Public Health, Hasanuddin University. Blood samples were collected by certified healthcare professionals and processed in a licensed laboratory.

Statistical analysis

All data were presented as mean ± standard deviation (SD). Data analysis was performed using SPSS, aligned with the study's objectives. Independent t-tests were used to assess differences in triglycerides, blood pressure, blood sugar, HDL, and abdominal circumference (as a measure of nutritional status) between the intervention and control groups. Paired t-tests were employed to evaluate changes within each group from baseline to post-intervention. Statistical significance was set at $P < 0.05$. Before conducting the t-tests, a normality test using the Kolmogorov-Smirnov test was performed, confirming that all variables were normally distributed.

RESULTS AND DISCUSSION

Characteristics of the subjects

The characteristics of the respondents are shown in table 1. The research participants included a total of 46 people. The respondents in the intervention and control groups were mostly women. The highest level of education of respondents in both groups was high school. Nutritional status based on body mass index, most respondents in both groups were in the normal category. Although in the intervention group, normal and overweight nutritional status were the same percentage. The difference between the two groups was the length of suffering from DM, in the intervention group, respondents suffered from DM a year or less, while in the control group, most of the respondents had suffered from DM for 3 years. Respondents in this study were DM outpatients. In both groups. most respondents were women and over 50 years old. One of the risk factors for type 2 DM is the age of >50 years, because at this age there is generally a rapid decline in physiological function,

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resulting to a deficiency of insulin secretion due to disorders of the β pancreas and insulin resistance. Men and women have the same risk of developing type 2 DM until early adulthood. When viewed from risk factors, women are more at risk of developing DM because physically women have a greater chance of increasing body mass index. Women's risk factors have a greater chance due to a greater increase in Body Mass Index (BMI). Monthly cycle syndrome (premenstrual syndrome), post menopause affects hormonal processes, leading to easier accumulation of body fat. Consequently, women are at a higher risk of developing DM.

Most respondents to this study in both the intervention and control groups, had experienced overweight or obesity (56.5% vs. 53.8%). Body Mass Index (BMI) is the most recommended measurement for the evaluation of obesity and overweight in children and adults. This is because besides being easy and affordable, BMI levels are related to body fat and risk factors for type 2 DM. Research analyzing data from the 5th wave of the Indonesia Family Life Survey (IFLS5), found that individuals with obese BMI had a significantly higher risk of developing DM compared to those with normal or underweight BMI (OR= 3.15; 95%CI=2.054.82). This increased risk remained significant ever after adjusting for sex, age and education level [23].

Effects of breadfruit leaf extract on blood pressure

The breadfruit leaves used in this study came from Gowa Regency, South Sulawesi which was carried out with the Freeze dryer process (HaiCuan brand) using temperatures -60 ºC (sublimation method) for 36 hours so that solid extracts were obtained. Freeze dryer is a tool used at the end of the maceration extraction process with water, namely to separate the extract from the water contained in breadfruit leaf extract. Extract breadfruit leaves are produced at the drug factory Pt.(IFI) Takalar so that the production process has met the requirements according to good drug manufacturing methods. Breadfruit leaf extract in this study is still a companion drug/supplement.

Table 2 illustrates the effects of breadfruit leaf extract on various metabolic parameters. Both the control group and breadfruit extract group showed significant changes in systolic and diastolic blood pressure pre-treatment and post-treatment ($p<0.05$). But the decrease in breadfruit leaf extract group was greater than in the control group, both in systolic blood pressure (15.43±2.57 vs 7.13±2.77 mmHg) and in diastolic blood pressure (5.00±2.27 vs 4.7±2.88 mmHg).

The study revealed significant differences in both systolic and diastolic blood pressure between the intervention group and control group, when comparing measurements taken before and after the intervention. However, the changes in the intervention group were better than those in the control group. This finding aligns with previous studies that found the effectiveness of breadfruit leaf extract in lowering

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blood pressure among prediabetic patients. Studies conducted on experimental animals have elucidated the mechanism of lowering blood pressure by breadfruit leaf extract. Intravenous administration of breadfruit leaf extract showed a reduction in systolic and diastolic blood pressure. The higher the doses of breadfruit leaf extract, the more pronounced the blood pressure reduction [24]. Breadfruit leaf extract does not exert a blood vessel dilation effect when incubated on the aortic ring, but provides a significant reduction in aortic ring contractions induced with phenylephrine. In addition, breadfruit leaf extract also provides relaxation to the aorta and lowers blood pressure contractions induced by calcium. The mechanism of lowering blood pressure by breadfruit leaf extract is caused by the content of flavonoids, saponins, and cardiac glycosides. Flavonoids and saponins in plants trigger a decrease in blood pressure and vasodilator activity [23, 24].

Effects of breadfruit leaf extract on blood glucose

The effect of breadfruit leaf extract on blood glucose is shown in table 2. Blood glucose levels in the control group and breadfruit leaf extract group were both significantly different in pre-treatment and post-treatment ($p<0.05$). But, the decrease in the breadfruit leaf extract group was greater than in the control group (76.44±49.86 mg/dL vs 23.83±8.37 mg/dL). This study found that based on the examination of fasting blood glucose levels, there was a significant decrease in both the intervention group and the control group. However, the changes in the intervention group were much better. Studies find that the phytochemicals found in breadfruit leaves are flavonoids, saponins, and tannins. The study found that breadfruit leaf extract had several effects, including reducing blood glucose levels in a male rat with type 2 diabetes [26]. Another study conducted to look at the effect of breadfruit leaf extract on blood glucose, lipid profile, and body weight in diabetic rats found that breadfruit leaf extract lowered blood sugar levels but significantly only at a dose of 400mg/kg [26]. Breadfruit leaf extract improves blood sugar levels and fat metabolism and can cause weight loss in diabetic rats [26]. The effectiveness of breadfruit leaves in lowering blood sugar in experimental animals is comparable to that of glibenclamide [28]. The use of breadfruit leaf extract also functions as hepatoprotective and prevents pancreatic damage [29].

Effects of breadfruit leaf extract on lipid profiles

The effect of breadfruit leaf extract is shown in table 2. HDL cholesterol and triglycerides in the control group and breadfruit leaf extract group were both significantly different in pre-treatment and post-treatment ($p<0.05$). But the changes in the breadfruit leaf extract group were greater when compared to the control group. HDL levels showed a greater increase in the breadfruit leaf extract group compared to the control group (21.09±15.43 mg/dL vs 6.31±6.0 mg/dL) and triglyceride levels decreased more in the breadfruit leaf extract group when compared to the control

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group (57.74 mg/dL ±35.72 vs 22.6±11 mg/dL). Based on the results of the examination of HDL levels in the intervention group and the control group before and after the intervention showed significantly different values. However, the changes in the intervention group were better than those in the control group. The intervention group had higher elevated HDL levels. A study showed that giving breadfruit leaf extract significantly increased HDL levels. Studies that assessed the effectiveness of breadfruit leaf extract on several metabolic indicators in rats found that breadfruit leaf extract significantly reduced organ weight and fat parameters, and increased serum HDL levels. Giving breadfruit leaf extract can provide a protective effect against the incidence of hypercholesterolemia.

Based on the results, triglyceride levels in the intervention group and the control group before and after the intervention showed significantly different values. However, the changes in the intervention group were better than those in the control group. This research aligns with previous studies that showed the efficacy of breadfruit leaf water extract (dose of 500 mg/kg body weight) in reducing triglyceride levels in hypercholesterolemic rats (*Rattus Norvegicus*) by 12.49%. The results of other studies in prediabetic patients given a dose of breadfruit leaf extract capsules of 500 mg/kg body weight given for 28 days can reduce triglyceride levels [15].

Breadfruit leaves contain flavonoids that are quite high. Flavonoids increase the activity of lipoprotein lipase thus affecting serum triglyceride levels. Under normal conditions fats derived from food will undergo a digestive process in the intestine into free fatty acids, and triglycerides; Phospholipids and cholesterol are absorbed into the form of chylomicrons. This increase in lipoprotein lipase activity causes the process of converting Very Low Density Lipoprotein (VLDL) to Intermediate Density Lipoprotein (IDL so that VLDL accumulation in the liver can be reduced, and blood triglyceride levels are strongly influenced by free fatty acid levels in the body through inhibition of HMG co-A reductase. In addition, flavonoids increase the activity of lipoprotein lipase enzymes which will increase the hydrolysis of triglycerides into fatty acids and glycerol into blood vessels. Body tissues or cells that need fatty acids and glycerol will burn these components to produce energy, namely carbon dioxide (CO_2) and water (H_2O). Flavonoids can inhibit the activity of lipogenic enzymes such as diacylglycerol acyl transferase (DGAT) which inhibits triglyceride biosynthesis resulting in a decrease in serum triglyceride levels. Tannins, compounds found in breadfruit leaves, play a protective role in the digestive system and influence lipid metabolism. This compound interacts with proteins in the body and forms a protective layer on the intestinal wall by compacting the mucous layer of the intestines. As a result, it may slow down the absorption of triglycerides and free fatty acids (FFA) in the blood [31].

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Effects of breadfruit leaf extract on the incidence of MetS

Based on the NCEP-ATP III classification, the incidence of MetS in pre-treatment was higher in the breadfruit leaf extract group when compared to the control group (91.3% vs 73.9%). The incidence of MetS decreased in post-treatment in both breadfruit leaf extract and control groups (39.1% vs. 52.2%). But, the breadfruit leaf extract group experienced higher improvements (52.2% vs. 21.7%) (Figure 1).

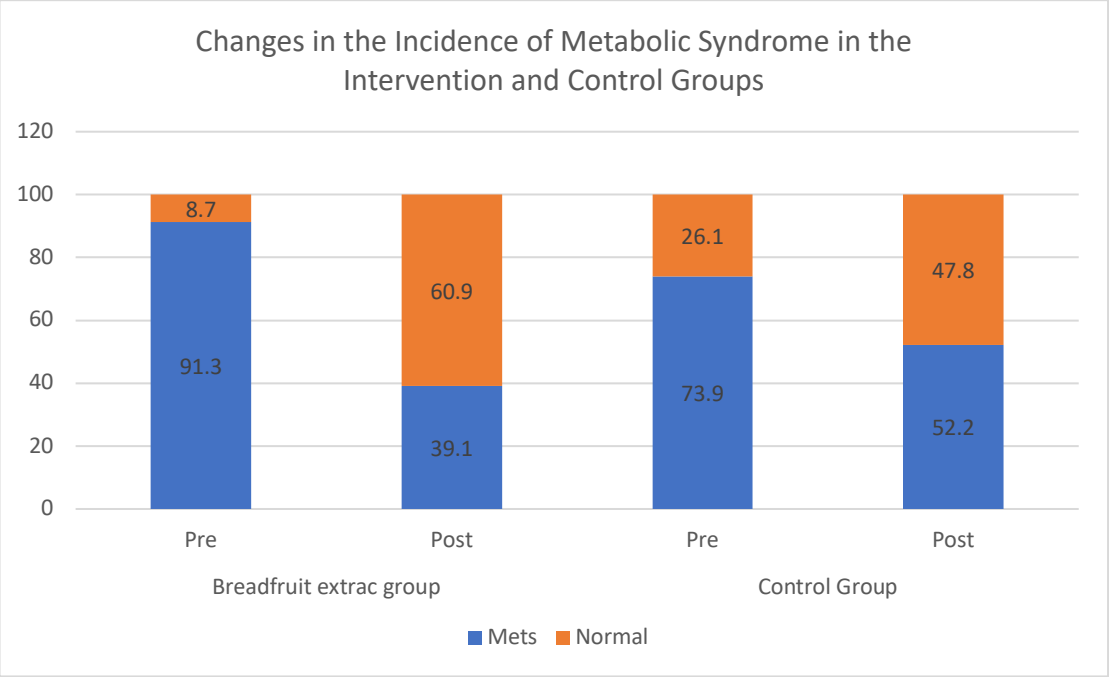

Figure 1: Changes in the Percentage of MetS Incidence in Respondents

A study found that breadfruit leaf boiled water can be used for the treatment of diabetes mellitus. Various studies conducted on experimental animals show that breadfruit leaves are effective in lowering blood glucose levels [32, 33]. Previous studies have found the effectiveness of breadfruit leaf capsules in improving metabolic status in prediabetics [15], but no one has studied its effectiveness in people with Diabetes Mellitus. Giving breadfruit leaf extract can improve the components of MetS in patients with type 2 diabetes. Food plants have the potential to improve metabolic parameters in the body. Apart from breadfruit leaves, there is rice bran oil. Research conducted by Refdanita found that administering 2 glasses of rice bran emulsion could reduce TNF-α levels, although not significantly [34]. In the control group, there were quite good changes, although not as good as in the intervention group because both groups received education. Education can be an effective prevention of MetS [35]. Education is provided to continue to improve and maintain the health of research subjects who are DM patients. Apart from breadfruit leaf extract, research subjects also continued to consume medicines provided by the

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health center and improved their diet. The results showed that the intervention group and control group both experienced significant improvements. However, changes in the intervention group were better than those in the control group.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

Consumption of breadfruit leaf extract for 21 days demonstrated effectiveness in improving several metabolic parameters in patients with DM. Specifically, the extract lowered systolic and diastolic blood pressure, blood glucose levels, and triglycerides, while it increased HDL cholesterol levels. Changes in metabolic syndrome components in DM sufferers were equally significant in both the breadfruit leaf extract group and the control group, but the changes in the intervention group were better when compared to the control group. The administration of breadfruit leaf extract can serve as a complementary therapy for DM patients with Mets. When combined with medical treatment and educational interventions, it yields significantly improved outcomes. Further research needs to be carried out with larger samples and a longer duration of intervention to confirm these results.

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AUTHOR DISCLOSURE STATEMENT

The author declares no conflict of interest

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Table 1: Characteristics of Respondents

Characteristic	Intervention (n=23)		Control (n=23)	
	n	%	N	%
Age (years)				
30-39	1	4.30	1	3.80
40-49	3	13.00	7	26.90
50-59	18	78.30	18	69.20
>= 60	1	4.30	0	0.00
Gender				
Male	7	30.40	5	19.20
Female	16	69.60	21	80.80
Educational Attainment				
Primary School or lower	5	21.70	3	11.50
Junior High	4	17.40	6	23.10
Senior high	7	30.40	10	38.50
College or higher	7	30.40	7	26.80
Length of suffering (years)				
1	7	30.40	3	11.50
2	6	26.10	13	50.00
3	5	21.70	9	34.60
4	5	21.70	1	3.80
Nutrition Status				
Thin	1	4.30	0	0.00
normal	9	39.10	12	46.20
overweight	9	39.10	7	26.90
obes	4	17.40	7	26.90

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Table 2: Effects of breadfruit leaf extract on Mets component

Component	Control (n=23)			Breadfruit leaf extract (n=23)		
	Pre-treatment	Post Treatment	Difference	Pre-treatment	Post Treatment	Difference
SBP (mmHg)	133.09±15.49	125.96±12.72	7.13±2.77*	135.43±15.87	120±13.30	15.43±2.57*
DBP (mmHg)	85.87±8.06	81.17±5.18	4.7±2.88*	85.00±9.65	80.00±7.38	5.00±2.27*
Glucose (mg/dL)	168.22±83.58	144.39±75.21	23.83±8.37*	243.7±130.09	167.26±80.23	76.44±49.86*
HDL (mg/dL)	46.6±15.83	52.91±9.80	6.31±-6.03*	41.82 ±21.22	62.91±36.65	21.09±15.43*
Triglycerides (mg/dL)	177.17±83.85	154.57±72.85	22.6±-11*	219.78±111.50	162.04±75.43	57.74±35.72*

*Pre and post-treatment values are significantly different at p<0.0

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