Modified Cassava Flour Dates Biscuit Effect on the Lipid and Anthropometry Profiles of Type 2 Diabetes

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Abstract

Purpose: To assess the effect of caromma biscuit consumption on the lipid profile and anthropometry of type 2 DM write our first time patients.

Design: A pretest-post-test randomized controlled trial (RCT) design was used on 33 subjects of an intervention group given caromma biscuits and 31 subjects of a control group given tempeh dates biscuits (temma) for four weeks. Anthropometry profile data collection included weight, height, waist-hip circumference ratio (WHCR), body fat percentage (BFP), blood pressure, and fasting blood glucose (FBG). Lipid profile included total cholesterol, Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL), and triglycerides collected before and after study.

Findings: The majority of subjects in both groups had over-nutrition, high body fat percentage, risk of central obesity from WHCR, pre-hypertension, and high fasting blood glucose. Lipid profile showed high cholesterol, LDL, and triglycerides, and low HDL. At the end of the study, there was an increase of weight, BMI (Body Mass Index), BFP, and WHCR in both groups. Blood pressure, FBG, cholesterol, LDL, HDL, and triglycerides decreased in both groups.

Practical implication: Lipid and animal protein intakes should be limited for type 2 diabetic patients. It can prevent high levels of lipid profile which is danger for them. Caromma and temma biscuits can be consumed by diabetic patients to obtain a positive blood lipid profile, but not for a improve anthropometric profile.

Keywords: Type 2 DM, caromma biscuit, temma biscuit, anthropometry profile, lipid profile

Introduction

Obesity, smoking, a lack of fruit and vegetable consumption, the consumption of too much sweet food, and a lack of physical activity, such as exercise, are the risk factors of Diabetes Mellitus (DM) (Basic Health Research, 2018). DM is often asymptomatic; thus, for a long time, the patients may have no idea that they have DM. When DM is finally diagnosed, some patients' blood glucose level have elevated without their realization. Changes in lifestyle including eating habits and physical activity are preventive measures for type 2 DM. This type of DM occurs mostly in developing countries in patients aged over 45 years without insulin dependency (Samuel D, 2006).

The appropriate diet of a DM patient includes the regulation of calories, carbohydrates, fat, and protein contained in the seven groups of food classification. One way to regulate food or diet is by choosing the amount and type of appropriate carbohydrates using the concept of the Glycemic Index (GI). Foods containing high GI increase blood glucose level quickly after the food has been

consumed. Foods high in gluten, such as flour, need to be avoided by diabetics because they can increase blood glucose level. Foods high in gluten can hinder metabolism in the form of nutritional absorption disorder in patients with type 1 and 2 diabetes, which leads to malnutrition in patients with DM (Sinta, 2013).

Various complications to other parts of the body, starting from blood vessels (atherosclerosis) to the heart (Coronary Artery Disease/CAD) can be initiated by DM. This is caused by hyperlipidemia in DM patients. Studies performed on type 2 DM patients in India proved triacylglycerol (TAG), VLDL, and cholesterol/HDL increased significantly (Jain H et al. 2016). The common nutritional status profile found in type 2 DM patients includes over-nutrition to obesity, WHCR over the cut-off point 0.8 for women and 0.9 for men, high body fat percentage (BFP), and hypertension. Most common characteristics found in type 2 DM include dyslipidemia, obesity, and hypertension. Dyslipidemia, commonly found in DM is insulin deficiency and resistance, which affects enzymes and the lipid metabolism pathway (Hirano, 2018). Dyslipidemia in type 2 DM patients is characterized by increased triglycerides, decreased HDL, and increased LDL (Chang YC et al. 2013).

Body fat percentage (BFP) and body mass index (BMI) have a significant correlation in DM patients. The majority of DM patients experience lipid disorder, i.e., dyslipidemia which is characterized by increased triglycerides, decreased HDL, and increased LDL. This abnormality can lead to CAD write out first time which aggravates the health status of DM patients (Kelley D.E., 2003). Management of type 2 DM consists of pharmacological and non-pharmacological therapy to maintain the blood glucose level at a normal value. One of the non-pharmacological efforts is the consumption of food with low glycemic index (GI) to manage normal BGL. Functional food consumption may improve this condition.

A pilot study regarding the effect of the caromma biscuit on BGL changes in 141 diabetics patients. The study showed an increase of BGL at postprandial two hours after consuming the biscuit (6.4 points) was the lowest in the intervention group (caromma biscuit) compared to control group (temma, mocaf tempe kurma, and dates biscuits) (Fatmah, 2017). However, the effect on the changes of the anthropometry profile and the lipid profile in DM patients has not yet been studied. This study aimed to assess the impact of caromma biscuit consumption on anthropometry profile (BMI, WHCR, BFP) and blood lipid profile (total cholesterol, LDL, HDL, and TAG).

Materials and Methods

Population and subject

The study used a quasi-experimental design on 66 type 2 DM patients in Depok City. Ethical clearance was obtained from the Research Ethics Committee of Health Research and Development Board of the Indonesian Ministry of Health. The research design was a single-blind randomized treatment-control experimental trial with 66 subjects. From the chosen DM patients, randomization was conducted to divide the subjects into two groups. The researcher knew the type of biscuit given to the intervention and the control group (Sastroasmoro and Sofyan Ismail, 2014).

Subjects were chosen when they met the inclusion criteria as follows: male or female; aged between 35-75 years; had DM for at least 12 months; currently consuming oral diabetic medication; currently

not drinking herbal medicine such as sour soup leaves, god's crown leaves, rosella tea, and other food that might decrease blood glucose; not currently suffering with a chronic disease such as cancer, CAD, stroke; diagnosed with type 2 diabetes mellitus by a doctor (based on fasting blood glucose level examination with the result of > 200 mg/dl and 2 hours after eating if > 126 mg/dl) (ADA, 2010); and have symptoms of DM, i.e. polyphagia, polydipsia, and polyuria, and rapid weight loss. A power analysis showed that 30 subjects were needed in this study to observe a difference in means of at least between the two groups. There was a total of 70 subjects for the treatment group and the control group after adding 5 subjects for each group.

Data collection and analysis

Sixty-four subjects divided evenly between two groups participated in this study. The treatment group was given a caromma biscuit, and the control group was given a temma biscuit, one package per day for four weeks. The compliance level of biscuit consumption was determined by a home visit every two days to record daily food consumption and the amount of biscuit distributed. In addition, the anthropometry profiles (BMI, FBG, blood pressure, BFP, waist-hip circumference ratio) and lipid profile (cholesterol, LDL, HDL, and triglycerides) were measured before and after the study. Baseline data was collected at the start of the study which included the characteristics of the subjects, history of DM, the health status of the subjects two weeks before the interview, and one-day food recall. Their body weight was analyzed using the 2007 World Health Organization standard with WHO Anthroplus software version 02, 2009 according to body weight/age indicator. Univariate data analysis was performed using SPSS program version 13.

Results

At the beginning of the study, there were 70 subjects evenly divided between two groups (each consisting of 35 people). However, 6 subjects dropped out, either through their own resignation or being asked to leave by the author. The reasons for leaving were: the subject felt bored and decided not to continue with the study (2 subjects), they went home without the assurance of returning (1 subject), they were admitted to the hospital for a few days (1 subject). Thus, biscuit consumption was stopped, or they complained of frequent urinating after biscuit consumption (2 subjects). The majority were females less than 60 years of age. The mean subject age was considered homogenous between the two groups from 50 years to 60 years. Subjects in the intervention and control group had mostly finished their education at a low level (nine years of education). More than three-quarters of the total subjects in both groups were unemployed (Table 1).

An anthropometry profile and lipid profile at pre and post-study is presented in Table 2. Anthropometry profile indicators including waist circumference, WHCR; and lipid profile represented by systolic blood pressure, cholesterol, LDL, HDL, and triglycerides had significant differences for both groups before and after the study. Only body fat percentage had significant difference at pre-post study between the groups.

Table 3 showed mean macro and micro-nutritional intake before and after the intervention. Each group had significant difference in fat, carbohydrate, and vitamin E intakes from before to after the study. Both groups had significance differences in protein intake at pre-post study with intervention group was a little bit higher than control group. Table 4 showed the macro-micronutrients contained

in both types of biscuit. The caromma biscuit had lower energy, fat, Fe, Zn than the temma biscuit. The fiber content in caromma biscuit was slightly higher, but the cholesterol content was slightly higher compared to the temma biscuit.

Discussion

Most subjects in both groups were overweight and obese due to their high body fat level, especially in the abdomen, leading to insulin effect resistance. This was supported by the majority of subjects having a WHCR higher than the cut off points mean defining obesity (WHO, 2008). Commonly, type 2 DM patients experienced dyslipidemia in the form of lipid metabolism disorder, i.e., increased total cholesterol level, triglycerides, LDL, and decreased HDL (Gordon et al, 2010). Decreased FBG level, cholesterol, LDL, and triglycerides in the intervention group of this study was consistent with a study of type 2 diabetes patients in India (Agrawal et al, 2012). However, no significant changes were found in the anthropometry profile of BMI and WHCR. Glycemic control was positively correlated with the blood triglyceride level. Excess glucose in the blood is stored in the form of fat, especially triglycerides during the advanced phase of the pathogenesis process of type 2 DM. Glucose was transformed into triglycerides, leading to an increased triglycerides level, which causes a lower HDL level and an increased cholesterol level in the blood (Parhofer KG, 2015).

Caromma biscuit can decrease FBG of diabetes patients by the high fiber content in mocaf flour (Tempo, 2014). This was in accordance with a pilot study, which found an increase of blood glucose post-prandial two hours after consuming the caromma biscuit in type 2 diabetics with the lowest point of 6.4 amongst the other kind of biscuits (Fatmah, 2017). The caromma biscuit had low GI value (< 55) according to the American Diabetes Association (ADA, 2014; Healthy Magazine, 2011; Food & Nutrition Center Laboratory of Gajah Mada University, 2015). It can decrease cholesterol absorption, dilute toxins, and increase short-chain fatty acid production. The high fiber content in mocaf flour as the main ingredient of caromma biscuit is assumed to help decrease cholesterol (Sinta, 2013). This was in line with the study conducted on type 2 DM patients. Cholesterol and LDL significantly decreased in type 2 DM patients after applying a low glycemic index diet (Majchrzak LC et al, 2014; Jarvi AE et al., 1999; Wolever TM et al, 1992; Fahime Z et al, 2016). Date jam has been proven not to increase the blood glucose level of diabetics because it contains low GI (Munadi and Dedi A, 2002).

Caromma and temma biscuits had low glycemic index. A low glycemic index diet in type 2 diabetic patients can decrease weight, BMI, and hip circumference (Lopez SV and Sandra NMK, 2009; Duygu S et al, 2018; Fatemeh S et al, 2019). Dates contained several phytochemicals such as carotenoid, polyphenol (phenolic acid), isoflavone, lignin, flavonoid, tannin, and sterol and fiber that can inhibit the absorption of LDL cholesterol. A study on date diet in rats with 1.5%, 2.5%, and 5.2% content can decrease triglycerides, cholesterol. Another study conducted on a healthy population with dates consumption found no increase of FBG, with triglycerides decreased by 15% (Mohan J, no year). Limited subject size and duration of intervention may not prove a significant correlation between the effect of caromma biscuit consumption and changes in anthropometry profile such as BMI and WHCR. Further studies are needed to prove both of the above with a larger number of subjects and a different intervention duration. In conclusion, the consumption of caromma and temma biscuits has potency affecting blood lipid profile positively (decrease cholesterol, LDL, and triglycerides).

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Appendix

Table 1 Socio-demography characteristic of the subjects

Variable	Type of biscuit			
	Group 1: caromma (n=33)		Group 2: emma (n=31)	
	n	%	n	%
Sex:				
Male	6	18.2	3	9
Female	27	81.8	28	90.3
Age :				
< 60 y.o	19	57.6	20	64.5
>= 60 y.o.	14	42.4	11	35.5
Mean + SD	57.4 + 9.9		53.4 + 8.7	
Last education level:				
Low (did not graduate from elementary – junior high school)	20	60.6	21	67.7
Middle (graduated from senior high school – academy/university)	13	39.4	10	32.3
Working status now:				
Does not work	26	78.8	27	87.1
Works	7	21.2	4	22.9

Table 2. Anthropometry and lipid profiles of subjects at pre-post study

	Group	Pre-study			Post-study			p*
		n	Mean	SD	N	Mean	SD	
Weight	Caromma	33	58.60	12.67	33	58.84	12.55	0.002
	Temma	31	61.18	9.33	31	61.37	9.60	0.057
	P		0.359			0.371		
BMI	Caromma	33	24.47	5.62	33	24.56	5.55	0.008
	Temma	31	26.68	3.82	31	26.75	3.92	0.072
	P		0.073			0.075		
Body fat percentage	Caromma	33	32.18	6.83	33	32.68	7.22	0.400
	Temma	31	35.96	5.34	31	35.90	5.15	0.907
	P		0.017			0.046		
Waist circumference	Caromma	33	80.16	13.73	33	83.09	13.43	0.000
	Temma	31	84.04	9.52	31	87.51	8.51	0.000
	P		0.197			0.123		
Hip circumference	Caromma	33	93.92	11.68	33	95.36	11.96	0.046
	Temma	31	97.63	9.84	31	98.31	7.88	0.504
	P		0.176			0.253		

Waist/hip circumference	Caromma	33	0.85	0.67	33	0.86	0.65	0.015
	Temma	31	0.86	0.66	31	0.88	0.40	0.006
	P		0.494			0.147		
Sistolic blood pressure	Caromma	33	121.52	16.23	33	115.76	18.71	0.029
	Temma	31	128.39	16.55	31	117.42	19.66	0.001
	P		0.099			0.730		
Diastolic blood pressure	Caromma	33	87.88	9.60	33	85.76	7.92	0.182
	Temma	31	88.71	9.91	31	87.10	7.83	0.378
	P		0.735			0.499		
Fasting blood glucose	Caromma	33	167.06	82.80	33	154.85	95.10	0.150
	Temma	31	173.19	92.72	31	150.06	73.64	0.095
	P		0.781			0.824		
Cholesterol	Caromma	33	239.73	35.30	33	195.70	34.13	0.000
	Temma	31	264.42	75.10	31	204.68	37.11	0.000
	P		0.072			0.317		
LDL	Caromma	33	145.18	29.89	33	122.24	29.00	0.000
	Temma	31	154.97	53.59	31	125.45	30.56	0.001
	P		0.114			0.668		
HDL	Caromma	33	61.00	17.76	33	51.12	15.40	0.000
	Temma	31	59.68	13.28	31	49.48	11.52	0.000
	p		0.738			0.633		
Trigliserida(sp)	Caromma	33	175.09	112.64	33	123.67	73.69	0.000
	Temma	31	226.00	172.56	31	152.48	99.88	0.007
	p		0.423			0.192		

p: uji t independen, p* uji t dependent

Table 3 Macro-micronutrient intakes changes of subjects at pre-post study

Type of nutrient	Group	Pre-study			Post-study			p*
		n	Mean	DS	n	Mean	DS	
Energy (kkal)	Caromma	33	1124.82	422.22	33	1237.85	358.28	0.161
	Temma	31	988.86	266.12	31	1107.77	234.87	0.038
	p		0.131			0.093		
Protein (gr)	Caromma	33	38.13	18.38	33	42.81	8.95	0.130
	Temma	31	35.28	15,14	31	38.10	8.04	0.320
	p		0.502			0.031		
Fat (gr)	Caromma	33	34.81	19.93	33	46.25	11.37	0.001
	Temma	31	34.87	15.33	31	46.06	11.91	0.001
	p		0.990			0.948		
Carbohydrate (gr)	Caromma	33	154.24	69.05	33	190.51	41.07	0.003

	Temma	31	129.54	59.84	31	172.75	33.29	0.001
	p		0.132			0.063		
Fiber (gr)	Caromma	33	6.31	3.22	33	8.14	3.05	0.004
	Temma	31	6.61	3.53	31	7.99	2.57	0.060
	p		0.720			0.833		
Cholesterol (gr)	Caromma	33	156.94	156.36	33	143.30	66.89	0.604
	Temma	31	81.73	86.20	31	128.20	72.24	0.015
	p		0.021			0.389		
Vitamin A (µg)	Caromma	33	343.72	456.29	33	455.83	295.10	0.269
	Temma	31	227.85	220.88	31	454.24	313.85	0.000
	p		0.205			0.983		
Vitamin E (mg)	Caromma	33	1.44	3.37	33	0.11	0.16	0.026
	Temma	31	1.23	2.50	31	0.15	0.19	0.018
	p		0.778			0.425		
Vitamin C (mg)	Caromma	33	38.37	57.58	33	38.36	30.43	0.821
	Temma	31	32.63	32.29	31	41.83	33.43	0.220
	p		0.628			0.666		
Natrium (mg)	Caromma	33	457.00	614.56	33	474.61	214.91	0.781
	Temma	31	587.78	719.53	31	415.34	224.57	0.217
	p		0.436			0.285		
Calcium (mg)	Caromma	33	214.85	228.46	33	237.48	244.48	0.400
	Temma	31	232.04	227.80	31	197.07	150.55	0.208
	p		0.764			0.432		
Iron (mg)	Caromma	33	5.25	3.58	33	7.72	4.14	0.000
	Temma	31	8.26	7.25	31	7.55	4.60	0.613
	p		0.038			0.876		
Zinc (mg)	Caromma	33	4.25	2.49	33	4.38	0.97	0.024
	Temma	31	4.82	2.71	31	4.78	0.95	0.931
	p		0.379			0.104		

p:independent t-test, p*: dependent t-test

DS : Deviation standard

Table 4 Nutrient contents of 100 gram biscuit

Type of biscuit	Energy (kkal)	Carbohydrate (gr)	Protein (gr)	Fat (gr)	Natrium (mg)	Iron (mg)	Zinc (mg)	Vit. A (IU)	Fiber (gr)	Cholesterol (mg)
Caromma	486	67.6	9.62	21,9	455	1.4	0.96	168	3.23	79.1
Temma	490	61.8	9.62	22,7	267	1.9	1.9	139	2.93	62.4

Source: BBIA Laboratory 2016