Blood glucose profile in healthy adults with *Nasi jagung* consumption habit

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Blood Glucose Profile in Healthy Adults with *Nasi Jagung* Consumption Habit

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Abstract. Dietary fiber reduces the risk of developing diabetes. *Nasi jagung* is one of Indonesian foods made from corn. It contains higher fiber than corn. *Nasi jagung* can be consumed as a staple food instead of rice. The present study aimed to analyze the relationship between fiber intake from *nasi jagung* with fasting blood glucose level. This cross-sectional study included 57 healthy adults aged 31-45 years with *nasi jagung* consumption habit. Fiber intake from *nasi jagung* was assesed by using semiquantitative food frequency questionnaire. Fasting blood glucose level was using capillary blood analysis. Spearman Rho was used to analyze relationship between fiber intake from *nasi jagung* and fasting blood glucose level ($\alpha=0.05$). The average of fiber intake from *nasi jagung* and fasting blood glucose level were 1.13 ± 1.2 g and 80.70 ± 7.7 mg/dl, respectively. The correlation test result indicated a negative correlation between fiber intake from *nasi jagung* and fasting blood glucose level (r= -0.348, p= 0.008). This study indicated that those with *nasi jagung* consumption habit may benefit from a reduction in the incidence of developing diabetes by controlling blood glucose level.

INTRODUCTION

Diabetes prevalence has increased faster in low-income and middle-income countries than high-income countries. Health Basic Survey of Indonesia indicated that diabetes mellitus prevalence has increased by 1.5% to 2.0 % from 2013 to 2018 in people aged above 15 years old [1]. Indonesian adults with diabetes number were in top five in the world in 2014 [2]. There is an urgent need to implement population-based intervention to prevent diabetes. Many studies suggested that higher level of consuming fiber will lower the incidence of dibetes.

A meta-analysis study showed that the increasing dietary fiber consumption in patients with type 2 dibetes mellitus will affect fasting blood glucose level and HbA1c profile. Fiber supplementation for type 2 diabetes mellitus intervention can reduce fasting blood glucose level to 0.85 mmol/L and HbA1c 0.26% [3]. Other umbrella review found similar result. The relative risk (RR) of type 2 diabetes mellitus also found decrease in population with high consumption of fiber, especially cereal fiber [4].

Dietary fiber is non-digestible carbohydrate and lignin which are not degraded in the upper gut. The most common classification of dietary fiber is according to its solubility in water. Both soluble and insoluble-fiber intake may decrease diabetes risk. Soluble-fiber intake may decrease risk of diabetes by delaying the absorption of dietary carbohydrate. It can reduce postpandrial glucose excursions. In the other hand, high insoluble-fiber intake may improve insulin resistance by interfering dietary protein absorption. Replacing 1% energy from animal protein with energy from plant protein is associated with a 18% decreased risk of type 2 diabetes mellitus. Insulin resistance was not worsen by high protein intake when the fibers were added. The main sources of soluble fiber are fruits and certain vegetables, whereas main sources of insoluble fiber are whole grains and products made from wheat and corn. Corn has potential effect on blood glucose level in type 2 diabetes patients [5-7].

Consuming corn flour muffin reduced insulin resistance by 30% [8]. Consuming high fiber from corn in the form of a snack food showed beneficial effect in insulin sensitivity in women with insulin resistance. Impaired insulin sensitivity condition will increase type 2 diabetes mellitus [9]. Corn is one of major commodities in Indonesia and its consumption level is abundant below the rice. In Indonesia, corn is usually processed into *nasi jagung*. It can be

consumed as staple food but nowadays people consume it also as snack. *Nasi jagung* contains high amount of fiber. It contains higher fiber than corn (6.2 g vs 2.2 g per 100 grams). The fiber was also higher than rice (0.2 g per 100 grams), dominant staple food that has been eaten by Indonesian [10]. Thermal effect on corn during *nasi jagung* processing lowers the water content. It will increase fiber content due to an increase in the concentration of solids due to a reduction in water content [11]. *Nasi jagung* can be effective for controlling blood glucose level from its high fiber contain.

Study of potential effect of nasi jagung on blood glucose level need to be done. It will added some information for dietary management of diabetes. The present study aimed to analyze the relationship between fiber intake from *nasi jagung* and fasting blood glucose level.

EXPERIMENTAL DETAILS

This study was cross-sectional study to assess relationship between fiber intake from *nasi jagung* and fasting blood glucose level. It was conducted in, Dusun Dawung. Candirejo Village, Pringapus District, Semarang Regency in May to June 2019. The area was chosen due to its high corn production and the population still consuming *nasi jagung* in their daily life. The study was ethically approved by Bioethics Commision Medical/ Health Research, Medicine Faculty Unnisula (No. 516/VIII/2019/*Komisi Bioetik*).

This study included 57 healthy women adults aged of 31-45 years with *nasi jagung* consumption habit and was acquired from purposive sampling technique. The exclusion criteria were subjects with diabetes mellitus, pregnant women, and in her menstrual period while blood sample was taken.

Data on the number of women adults were obtained from the local government. *Nasi jagung* consumption habit data were taken by using semiquantitative-food frequency questionnaire (SQ-FFQ) methods. Subjects were asked The consumption of *nasi jagung* were askedn for the previous month. It was classified, as always (≥1 times/day), often (≥3 times/week), sometimes (1-2 times/week or 1-3 times/month), and never [12]. Fasting blood glucose level was using capillary blood analysis in sitting position by using digital glucometer Autocheck. It was classified as hypoglicemia (< 70mg/dl), normal (70 - <100 mg/dl), prediabetes (100-125 mg/dl), and diabetes (≥126 mg/dl) [13]. Measurements were performed by trained nutrition student and lecturer. Fiber intake from *nasi jagung* and fasting blood glucose level were expressed as mean ± standard devation (SD). Data were analyzed by using Spearman Rho (α=0.05).

RESULTS AND DISCUSSION

Table 1 shows the result of subject characteristics. The complete education level of the subjects were dominated by primary 39 (68%), junior high school 13 (22.8%), and 5 (8.8%). Most of occupation of the subjects was 20 (35.1%) subjects unemployment and 20 (35.1%) farmer.

TABLE 1. Subjects Characteristics

Characteristics	N	%
Total subjects	57	
Education Level		
Primary	39	68.4
Junior high school	13	22.8
High school	5	8.8
Occupation		
Unemployment	20	35.1
Employee	15	26.3
Farmer	20	35.1
Enterpreneur	2	3.5

Subjects food consumption habits in the previous month are shown in Table 2. Most of subjects consumed *nasi jagung* in sometimes category (44 subjects or 77.2%), 11 (19.3%) were often, 2 (3.5%) were never. Subjects with total energy intake ≥80% recommended daily allowance of Indonesia or in good category were 39 (68.4%) and 18 (31.6%) were in poor category or consumed energy <80% recommendation. 49 (85.9%) had total fiber intake in good category and 8 (14.1%) in poor category.

The mean of fiber intake from *nasi jagung* was 1.13±1.2 g and fasting blood glucose was 80.70±7.7 g/dl. The correlation test result indicated a negative correlation between fiber intake from *nasi jagung* and fasting blood glucose level (r= -0.348, p= 0.008) (Table 3).

TABLE 2. Subject Food Consumption Habit

Food Consumption Habit	N	%
Total subjects	57	
Energy intake		
< 80%	18	31.6
≥ 80%	39	68.4
Frequency of *nasi jagung*		
consumption[12]	11	19.3
Often	44	77.2
Sometimes	2	3.5
Never		
Total fiber intake[13]		
< 20 g	8	85.9
≥ 20 g	49	14.1

TABLE 3. Fiber Intake from *Nasi Jagung* and Fasting Blood Glucose Profile

	Minimal	Maximum	$\bar{x}$ ±SD	r	p
Fiber intake from *nasi jagung* (g)	0	4.96	1.13±1.2	-0.348	0.008
Fasting blood glucose profile (mg/dL)	69	104	80.70±7.7		

This study found that total fiber intake from *nasi jagung* may reduce fasting blood glucose level. *Nasi jagung* is a better source of fiber than rice [10]. Dietary fiber has important physiological effects on glucose, lipid metabolism, and mineral bioavailability. Dietary fiber intake provides many health benefits, including diabetes [14]. The benefits are not only for adults but also for children [15].

Many studies had found that fiber has strong correlation between dietary fiber intake and diabetes. Most of subjects in this study had total fiber intake ≥ 20 g/d or in good category. Risk of diabetes was 22% lower when women consumed an average of 26 g/d comparing to women only consuming 13 g/d [16]. An additional 12 g of dietary fiber per day was proven lowering risk of diebetes in men and women [17]. Both of studies proposed that dietary fiber is associated with type 2 diabetes independent of other compounding factors, such as age and body weight.

According to researchs, soluble dietary fiber *versus* insoluble dietary fiber may give some differences mechanisms on diabetes by controling blood glucose level. Soluble fiber demonstrated decreased absorption of macronutrients, resulting in lower postpandrial blood glucose and insulin level [18]. However, several studies demonsrated the opposite result showing no correlation between soluble and lower risk of diabetes. A strong inverse relationship was found between insoluble fiber and the risk of diabetes [16,17,19]. Interestingly, a study of 42.000 men found that fiber from fruits and vegetables had no effect on the risk of diabetes. However, dietary fiber from whole cereal grains showed a significant decrease in diabetes occurrence [20].

The mechanism of insoluble fiber on diabetes risk may be from its capability to increase passage rate of foodstuff through the GI tracts, and thus resulted in decreased absorption of simple carbohydrate. In healthy women, after ingestion of insoluble fiber, an accelerated secretion of glucose-dependent insulint polypeptide (GIP) was obeserved. GIP stimulates postpandrial insulin release. Insoluble fiber also reduces food appetite and food intake that may lead to lower caloric intake [21-23].

In natural resources of fiber, soluble fiber are always combined with insoluble fiber. In general recommendation, people need to improve their daily dietary fiber intake to meet recommendation. Relatively, high fiber levels can be consumed when given as unprocessed foods without causing gastrointestinal problems [24].

Nasi Jagung was one of staple foods in many provinces in Indonesia. Nowadays, most of population in Indonesia shifted to rice as their staple food. In this study, population of *nasi jagung* consumption habit also shifted to rice. Subjects consumed both rice and *nasi jagung* as their staple foods. This study found that two subjects did not consume *nasi jagung* in previous month. Both subjects stated that most of farmer shifted to cultivate paddy and better infrastructures for food access stimulated them to eat more rice than *nasi jagung*. For economic reason, subjects sometimes mixed up rice with *nasi jagung* and vegetables available in their own yards as the side dish.

Traditional foods are neglected over time as functional food to be part of healthy lifestyle. *Nasi jagung* is one of traditioanal foods of Indonesia which may has potential role as functional foods. Its nutrient content has beneficial effects on health. The understanding about nutrient content and bioavailability of local foods will help us to improve dietary recommendation guidelines for local population [25].

SUMMARY

An inverse correlation was found between total fiber intake from *nasi jagung* with fasting blood glucose level. This result indicated that those with *nasi jagung* consumption habit may benefit from a reduction in the incidence of developing diabetes by controlling blood glucose level.

ACKNOWLEDGMENTS

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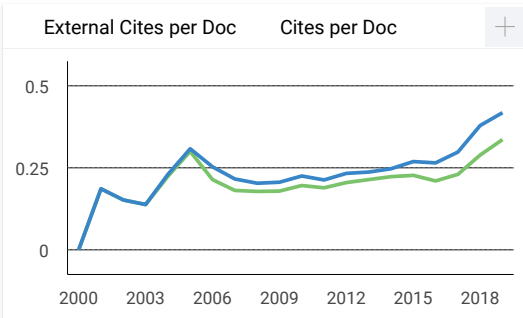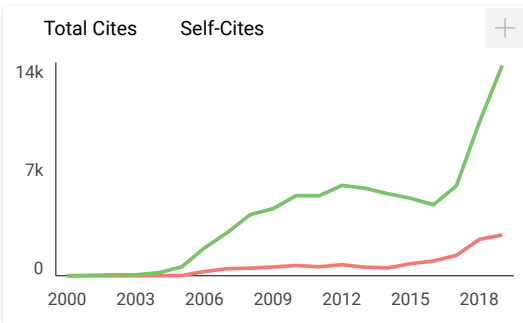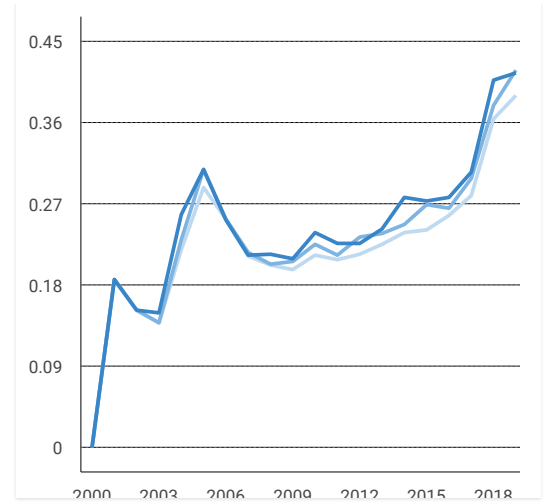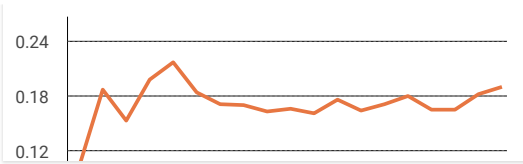
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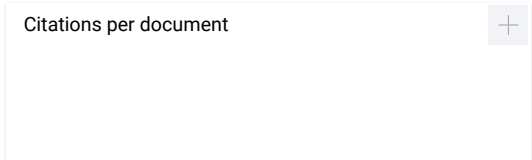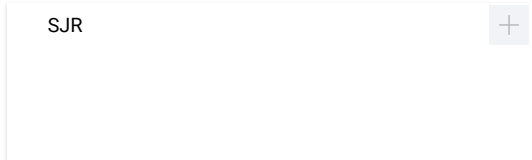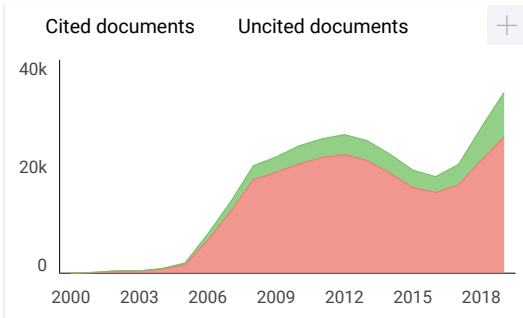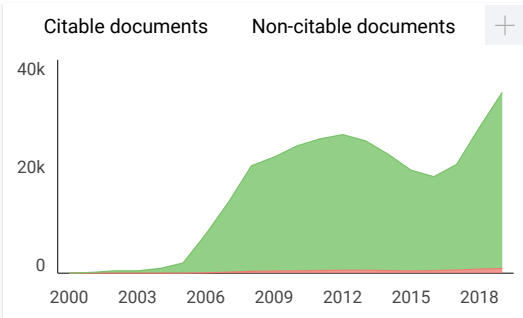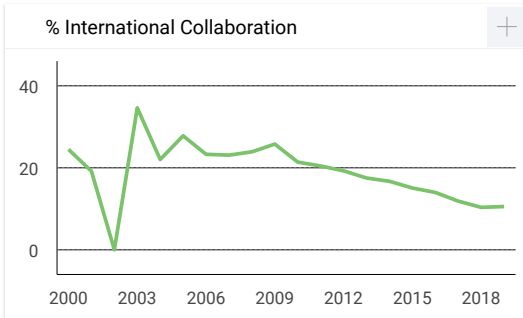
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