# The effect of Providing Food Made from Resistant Starch Fiber (*Dioscorea Esculenta, Maranta Arundinaceae L, Cucurbita Moschata,* Manihot *Utilissma)* on the Improvement of Glycated Albumin in Type 2 Diabetes Mellitus Patients at Dr. Sardjito General Hospital

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## Abstract

**Background.** One of characteristics in Diabetes diet is giving food with high complex carbohydrate, particularly fiber. The benefit of resistant starch fiber include maintaning blood glucose and increasing the insulin sensitifity.
**Aims.** This study aimed to find the effect of providing food made from resistant starch fiber (Dioscorea esculenta, Maranta arundinaceae L, Cucurbita moschata, Manihot utilissma) on the improvement of blood glucose control in diabetes patients based on glycated albumin test.
**Methods.** The Quasi-experimental study was used in diabetes type-2 patients who visited endocrinology polyclinic at Dr Sardjito Hospital, during 1 November 2015-31 January 2016. Food made from resistant starch fiber was served as a daily snack for one month. Blood glycated albumin was examined before and after food providence. SPSS was used for statistical analyses.
**Results.** We recruited 17 subjects in the control group and 17 subjects in the treatment group. In the control group, the index of albumin was significantly deteriorated from 15.1% to 18.13%. In the treatment group, the index of albumin was reduced from 29.71% to 18.73% showing an improvement of 10.97% (p= 0.01).
**Conclusion.** There was a significantly improvement of blood glycated albumin (10.97%) after consuming food that is made from resistant of starch fiber (p=0.01).
**Keywords:** *Diabetes type 2, food made resistant starch fiber, Glycated albumin*

## Abstrak

***Latar Belakang.*** *Salah satu ciri khas dari diet Diabetes Melitus (DM) tipe 2 adalah pemberian makanan tinggi karbohidrat kompleks terutama serat. Diet pati resisten berfungsi untuk mengatur agar glukosa darah tidak meningkat secara signifikan dan meningkatkan sensitivitas insulin pada DM.*
***Tujuan Penelitian.*** *Mengetahui pengaruh pemberian makanan berbahan dasar serat pati resisten (Dioscorea esculenta, Maranta arundinaceae L, Cucurbita moschata, Manihot utilissma) terhadap perbaikan kendali glukosa darah pasien Diabetes Mellitus tipe 2 berdasarkan pemeriksaan albumin terglikasi.*
***Metode.*** *Uji Kuasi Experimental pada pasien DM tipe 2 Obes yang kontrol di poli endokrin RSUP Dr. Sardjito, selama tanggal 1 November 2015-31 Januari 2016. Subyek diberikan konsumsi makanan dalam bentuk makanan ringan berbahan dasar serat pati resisten selama 1 bulan, dan di hitung albumin terglikasi sebelum dan setelah perlakuan dan dibandingkan dengan kelompok kontrol. Hasil diuji dengan SPSS untuk mencari perbedaan rerata.*

***Hasil Penelitian.*** *Sebanyak 17 subyek dalam kelompok kontrol dan 17 subyek dalam kelompok perlakuan dianalisis. Pada kelompok kontrol, indeks albumin terglikasi mengalami perburukan dari 15,1 % menjadi 18,13 %. Sebaliknya pada kelompok perlakuan, indeks albumin terglikasi menurun dari 29,71 % menjadi 18,73 % atau terdapat perbaikan sebesar 10,97% (p=0,01).*
***Kesimpulan.*** *Terdapat perbaikan kadar albumin terglikasi secara klinis dan statistik sebesar 10,97% pada kelompok yang mendapatkan makanan berbahan dasar serat pati resisten bila dibandingkan dengan kelompok yang tidak mendapatkan diet serat pati resisten (p=0,01).*

***Kata Kunci:*** *Diabetes type 2, makanan serat pati resisten, Albumin terglikasi*

## Introduction

Diabetes Mellitus (DM) is a chronic disease. *World Health Organization* (WHO) predicts the increase of frequency of diabetes patients in Indonesia from 8.4 million in 2000 to 21.3 million in 2030.[1]

Management in DM consists of education, lifestyle modification, physical exercise, diet modification and pharmacology treatment.[1] One particular diet in DM type 2 is carbohydrate complex, high fiber and low simple carbohydrate. Resistant Starch fiber can control the blood glucose because it is slowly digested, slower transit time and improve the insulin sensitivity.[2]

Resistant Starch Fiber has high viscosity and can block glucose absorbtion, thus it will decrease blood glucose.[3,4] Resistant starch fiber is fermented in colon because of microflora and produces short chain fatty acid such as acetate, propionate and butyrate which improve insulin sensitivity.[3,5,6] Some of roots have a fiber resistant starch fiber compotition such as *gembili* (*Dioscorea esculenta*), *garut* (*Maranta arundinacea*), *kimpul* and *gadung*.[7] The result of study in diabetes experimental Wistar mouse shows a significant blood glucose decrease in a group provided with *gembili* as a diet.[8]

One of an accurate long biomarker of glycemic control is glycated albumin. This test can show glycemic control within 2-4 weeks before.[9]

This study aimed to give evidence about the good effect of providing food containing resistant starch fiber to improve glycemic control in diabetes type 2 patients based on glycated albumin test.

## Methods

This study was *Quasi Experimentally* designed. This study was one of a part in the study by dr. Sunarti, M.Kes titled "Therapy of food based on *Gembili* as antidyslipidemia and antihyperglicemia in Diabetes Mellitus type 2 subject" with *ethical clearance* number KE/FK/1073/EC (28 August 2015).

The study was done in Endocrinology clinic, Department of Internal Medicine, Dr. Sardjito General Hospital Yogyakarta during 1 November 2015 until 31 January 2016. Study subject were hospital employees with diabetes and obesity. They were patients with type 2 diabetes, obesity with body mass index > 23.5 kg/m$^2$, regularly used willing to participate in the study.

Exclusion criteria for this study included alcohol consumption, pregnancy, have severe infection, with renal inuficiency (creatinine >1.5 mg/dl), hypoalbuminemia, proteinuria

>3.5 gr/day, hipertiroidism, malnutrition, hypotiroidism, chonic heart failure, icteric, liver cirrhosis, drink anorectic, steroid drugs, and the use sulfonylurea, acarbose, DPP IV Inhibitor, and GLP1 agonist.

The subjects was given food in a form of 32 gram snack for a month, consisting of fiber resistant starch fiber from *gembili* (*Dioscorea esculenta), garut (Maranta arundinaceae L), labu kuning* (*Cucurbita moschata),* and *singkong* (*Manihot utilissma)* with total calories 144.55 and resistant starch of 14.91%. Subject was educated about diet in diabetes. Calory counting was done every day by telephone interview and home visit by diabetic nutritionist. Glycated albumin were checked before and after one month.

Univariat analysis was done for each variable, distribution and characteristic of subject. Data was analyzed using SPSS and presented as means ± standar deviation. Normality data test continue used *Saphiro-Wilk*. M*ann Whitney* test was used to analyze and compare the means of glycated albumin in both groups. Unpaired t-test was used if the data was normally distibuted and *Mann Whitney* if the data not normally distibuted. Significant level of this study was $p < 0.05$.

This study has been approved by ethical comitte of biomedical Faculty of Medicine Gadjah Mada University and permitted by the Director of Dr. Sardjito General Hospital Yogyakarta. Each subject provided a concent to participate.

## Result

This study included 17-control subject and 17 subjects who received food based on resistant starch fiber. Baseline characteristic is showed in table 1.

Mean of age in the control group was 53.82 years and in experimental group 54.12 years. Male ini control group was 47.1% compared to 41.2% in experimental group. Body mass index control group was 28.64 kg/m$^2$ and experiment group was 28.5 kg/m$^2$.

Table 2 showed a rise of body mass index from 28.64 kg/m$^2$ to 28.69 kg/m$^2$ in control group and 28.5 kg/m$^2$ to 28.54 kg/m$^2$ in experimental group, but the differences were not statistically significant. In control group, glycated albumin increased from 15.1% to 18.13 %. In the experimental group, glycated albumin improved from 29.71 % (fail control) to 18.73 % (good control).

From table 2 we got the delta albumin in the group that did not get additional food-based resistant starch fiber was increased about 3.02 ± 7.13% glycated albumin, and in the group which got additional food-based fiber resistant starch fiber have improvement of glycated albumin equal to 10.97 ± 14.6% ($p = 0.01$).

In control group, failed subjects (17.6%) increased from 3 to 5 subjects (29.4%) and good test decreased from 13 subjects (76.5%) to 12 subjects (70.6%). In experimental group very good response improved from 8 subjects (47.1%) to 11 subjects *64.7%) and in fail group down from 7 subjects (41.2%) to 4 subjects (23.5%) (see table 3).

**Table 1** Characteristic Data subject

| Characteristic | Frequency Therapy group | Frequency Control Group | P |
|---|---|---|---|
| Age (years) | | | |
| Mean | 54.12 ± 2.6 | 53.82 ± 2.8 | 0.756** |
| Sex: | | | |
| - Male (%) | 7 (41.2%) | 8 (47.1%) | 0.734* |
| - Female (%) | 10 (58.8%) | 9 (52.9%) | |
| Education: | | | |
| - High School (%) | 5 (29.4%) | 6 (35.3%) | 0.826* |
| - Diploma (%) | 7 (41.2%) | 6 (35.3%) | |
| - Bachelor (%) | 5 (29.4%) | 5 (29.4%) | |
| Comorbid: | | | |
| - Hypertension (%) | 4 (23.5%) | 3 (17.6%) | 0.910* |
| - Cardiac (%) | 2 (11.8%) | 3 (17.6%) | |
| - Post Stroke (%) | 2 (11.8%) | 2 (11.8%) | |
| - No Comorbid (%) | 9 (52.9%) | 9 (52.9%) | |
| Diabetes Medication: | | | |
| - Metformin (%) | 8 (47.1%) | 8 (47.1 %) | 0.99* |
| - Insulin (%) | 3 (17.6%) | 3 (17.6%) | |
| - Insulin and metformin (%) | 3 (17.6%) | 3 (17.6%) | |
| - No therapy (%) | 3 (17.6%) | 3 (17.6%) | |
| Another medication : | | | |
| - Anti hypertension (%) | 3 (17.6%) | 2 (11.8%) | 0.812* |
| - Anti coagulant (%) | 2 (11.8%) | 2 (11.8%) | |
| - Anti dyslipidemia (%) | 3 (17.6%) | 3 (17.6%) | |
| - Anti hypertension and anti coagulant (%) | 0 (0%) | 1 (5.9%) | |
| - Combination anti hypertension, anti coagulant, anti dyslipidemia (%) | 1 (5.9%) | 1 (5.9%) | |
| - No medication (%) | 8 (47.1%) | 8 (47.1%) | |
| Physical exercise : | | | |
| - Walking (%) | 5(29.4%) | 5 (29.4%) | 0.99* |
| - *Treadmill* (%) | 1 (5.9%) | 1 (5.9%) | |
| - Cycling (%) | 6 (29.4%) | 5 (29.4%) | |
| - No excersise (%) | 6 (35.3%) | 6 (35.3%) | |
| BMI (kg/m$^2$) | 28.5± 3.46 | 28.64 ± 3.3 | 0.886* |
| Smoking | 4 (23.5%) | 5 (29.4%) | 0.006* |
| Creatinin (mg/dl) | 0.90 ± 0.20 | 0.93 ± 0.21 | 0.7** |
| Albumin (g/dl) | 5.67 ±1.03 | 5.67 ± 1.02 | 0.9** |

*$p < 0.05$ was statistically significant difference *t-test **Mann Whitney test*

## Discussion

In baseline characteristic of the study, there were no significant differences in age, sex, education, comorbid, medication and body mass index. Thus, all basic factors did not influence the study results.

One study showed that the albumin was not different by sex, unlike HbA1c, which was significantly higher in men than in women. One study mentioned that the published albumin reflects postprandial hyperglycemia and indicates glycemic fluctuations. Invalid albumin levels are associated with HbA1c levels. Glycated albumin will be affected in conditions that interfere with albumin metabolism. Glycated albumin will be lower in patients with nephrotic syndrome, severe obesity, hyperthyroidism and glucocorticoid use. Glycated albumin is higher in patients with

**Table 2** Comparison of body mass index and glycated albumin (%) in control group and experimental group

| Variable | Experimental | Control | P value |
|---|---|---|---|
| | Means (SD) | Means (SD) | |
| IMT (kg/m$^2$) Pre | 28.50 ± 3.46 | 28.64 ±3.33 | *0.88 |
| IMT (kg/m$^2$) Post | 28.54 ± 3.02 | 28.69 ±2.89 | *0.81 |
| Glycated albumin (%) Pre | 29.71 ± 22.93 | 15.1 ± 12.03 | **0.667 |
| Glycated albumin (%) Post | 18.73 ± 15.97 | 18.13 ± 16.43 | **0.66 |
| Δ Glycated albumin | -10.97 ± 14.6 | 3.02 ±7.13 | **0.01 |

*$p < 0.05$ was statistically significant difference * t-test; ** Mann Whitney test; Δ pre-post test of glycated albumin*

**Table 3** Subanalysis comparison of group glycated albumin (%) in control group and experimental group

| Variable | Pretest | | p | Post test | | p |
|---|---|---|---|---|---|---|
| | Control | Experimental | | Control | Experimental | |
| Very good | 13 (76.5%) | 12 (70.6 %) | 0.132 | 8 (47.1%) | 11 (64.7 %) | 0.5 |
| Good | 1 (5.9 %) | 0 | | 2 (11.8%) | 2 (11.8 %) | |
| Fair | 0 | 0 | | 0 | 0 | |
| Fail | 3 (17.6%) | 5 (29.4 %) | | 7 (41.2 %) | 4 (23.5 %) | |

cirrhosis of the liver and hypothyroidism. In the obese group, glycated albumin also showed lower levels due to chronic micro-inflammation of cytokines secreted by obese adipose subjects, which would increase albumin catabolism and shorten the albumin cycle. Glycated albumin is also lower than blood glucose in patients with smokers, hyperuricemia, hypertriglyceridemia, and non-alcoholic fatty liver disease.[10,11] In this study, the increased levels of glycated albumin were increased in the control group; this is still possible due to glucose fluctuations or postprandial glucose rise, which was not assessed in this study.

Metformin is an oral drug that shows a decrease in HbA1c ranging from 0.2% -2%. In this study with the change of dietary resistant starch was detected 10.97% decreased of glycated albumin. This opens a possibility of resistant starch fiber to be added for DM management strategy in controlling blood glucose.[6]

High starch fiber versus low fiber foods has been proven to be suitable for patients with type 2 DM. Lifestyle changes with an increase in fiber mean in the included study is about 18 g / day; to apply this in one's diet will include eating a bowl of high fiber cereal and adding more servings of vegetables a day. The American Diabetes Association recommends consumption of 30-50 grams of fiber per day in patients with type 2 diabetes. Epidemiological studies show that increased fiber intake will lower the risk of coronary heart disease.

Research Hallstrom et al.[12] showed that administration of 7.7 grams of resistant starch fiber, high wheat amylose would lower blood glucose and increase insulin. In the study of Al Tamimi et al.[13] the administration of 20 grams of resistant starch would lower blood glucose levels.

Polysaccharide content in *gembili* has the ability to lower blood glucose by decreasing the absorption of blood glucose in the intestines. Non-starch fibers, which also contain cellulose, lignin, and insoluble inulin, will shorten transit time in the intestines. In the colon, carbohydrate compounds that are not digesting by digestive enzymes fermented by bacteria and produce major short chain fatty acids such as acetic acid, propionic acid and butyric acid. The type of short-chain fatty acids produced depends on the source of food consumed. Short chain fatty acids are able to control the body's metabolism, which among others was to regulate insulin sensitivity, regulate the secretion of hormones in the digestive tract and regulate other metabolic processes. The magnitude of acetate, propionate, butyric formation is influenced by environmental conditions of colon, microbiota type and free fatty acid receptor 2 and free fatty acid receptor 3.[14]

## Conclussion

In this study it was shown that there was a significant improvement of glycated albumin in the group receiving dietary supplementation based on resistant starch fiber. advanced research with randomized and assessed uric acid and triglycerides that may interfere with albumin glycation and glucose examination can improve the accuracy of this research.

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