The efficacy of okra (*Abelmoschus esculentus*) in decreasing blood sugar levels among patients with impaired fasting glucose in Antipolo City

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Abstract

Introduction Previous studies have shown conflicting results on the efficacy of okra on lowering blood sugar levels. This study aimed to determine the efficacy of okra in decreasing blood sugar among patients with impaired fasting glucose.

Methods This was a randomized double-blind trial among patients with impaired fasting blood glucose from three clinics in Antipolo City. Potential subjects were identified from records of the three clinics, recruited and screened using the Finnish Diabetes Risk Score (FINDRISC) and fasting blood sugar (FBS). Eligible patients were randomly assigned to receive okra or placebo capsules twice daily for one month. The blood sugar after 30 days was compared with the baseline and the difference between the okra and placebo groups was compared.

Results There was a significant difference between the pre-treatment and post-treatment FBS levels, respectively, of both the okra and placebo groups (p-value <0.01). However, the difference between the mean difference of the okra and placebo groups was not significant (p = 0.06).

Conclusion The present study showed that okra capsules are not efficacious in lowering blood sugar levels.

Key words: Pre-diabetics, impaired fasting glucose, okra

The prevalence of diabetes mellitus (DM) is a global concern that cuts across geographical boundaries, regardless of status, race, age, or sex. It is considered as one of the most common public health problems in the 21st century. According to the World Health Organization, approximately 180 million people worldwide are affected with type 2 DM, which will likely double by the year 2030.[1] In the Philippines, DM is ranked as the eighth leading cause of mortality.[2] Type 2 diabetes accounts for 90 to 95% of all cases of DM, which is almost always preceded by pre-diabetes.[3] Without intervention, 15 to 30% of pre-diabetics will develop type 2 diabetes in five years.[4] As such, early screening and intervention of pre-diabetics is the first step towards decreasing the incidence of diabetes. According to the American Diabetes Association, pre-diabetes is also known as impaired fasting glycemia (IFG).[5] This

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is a state of elevated blood glucose levels during periods of fasting; however, these levels do not reach the threshold that prompts a diagnosis of diabetes. It is characterized as fasting plasma glucose levels between 100 and 125 mg/dl. In the Philippines, the total prevalence of IFG is 7.2%.[6] The public health burden of diabetes remains enormous. The magnitude of the epidemic prevalence, long term complications, costly treatment, and adverse effects make the prevention of diabetes a critical public health goal.

There have been an increasing number of people who have been taking okra for its purported ability to decrease blood sugar levels. Previous studies showed that *Abelmoschus esculentus*, or okra, reduces the absorption of sugar in the intestinal tract. One study explored the anti-diabetic potential of *A. esculentus* peel and seed powder in diabetic rats.[7] Results showed that okra was effective in lowering the rats' blood sugar levels. Findings from another study revealed that the viscous soluble dietary fiber of *Abelmoschus esculentus*, significantly reduced the intestinal absorption of glucose in fasting rats.[8]

However, another study showed that okra retarded the absorption of metformin, suggesting that diabetic patients taking metformin should be advised against adding okra to their diet. This contradicting interaction is the reason behind why this study did not support the addition of okra as an adjunct to metformin. One study that made use of human subjects focused on the effects on diabetic nephropathy which showed that okra has an effect on diabetic nephropathy than on plasma globulin and cholesterol.[9]

The general objective for this study was to determine the efficacy of okra in decreasing blood sugar among patients with impaired fasting glucose. Specifically, this study aimed to determine the mean decrease between post-treatment FBS and pre-treatment FBS of both treatment and control groups.

Methods

This was a randomized double-blind trial among patients with impaired fasting blood glucose from three clinics in Antipolo City comparing okra with placebo in decreasing blood glucose. Potential subjects were identified from records of the three clinics, recruited and screened using the Finnish Diabetes Risk Score (FINDRISC) and fasting blood sugar (FBS). Eligible patients who had previously given their consent were randomly assigned to receive okra or placebo capsules twice daily for one month. The blood sugar after 30 days was compared with the baseline and the difference between the okra and placebo groups was compared. The study was approved by the Ethics Review Committee.

The researchers reviewed the records at three private health clinics in Antipolo City after obtaining consent from the attending physicians. Patients with a history of at least two instances of elevated FBS levels for a period of one year from June 2014 to June 2015 were identified and recruited. Informed consent was obtained from those who agreed to join the study. To classify their risk of developing type 2 diabetes within 10 years, the Finnish Diabetes Risk Score questionnaire was used to assess these subjects based on their age, BMI, waist circumference, physical activity, diet, intake of anti-hypertensive medication, history of elevated blood glucose, and family history of diabetes. A minimum score of 7 indicated an elevated risk. The use of FINDRISC has been proven to be an accurate tool in screening for undiagnosed type 2 diabetes in the Philippines.[10]

Patients who satisfied the FINDRISC criteria underwent a fasting blood sugar (FBS) determination. Those whose FBS was 100 to 125 mg/dL were randomly assigned to the okra or placebo group. A subject was excluded from the study if he/she had: 1) been diagnosed with comorbidities known to elevate blood glucose levels, including thyroid disease, hormone imbalances (acromegaly, Cushing's disease), asthma, or chronic lung disease; 2) a history of cardiovascular disease; 3) not fully recovered from an infection; 4) been taking medication such as metformin, steroids, ciprofloxacin, thiazide diuretics, beta-antagonists, niacin, phenytoin; 5) failed to comply with the prescribed regimen for 30 days; 6) failed to follow up after 30 days; or 7) relocated residence. A sample size of 24 subjects was computed based on a difference to be detected of 8 mg/dL, SD = 98. Mg/dL, 95% CI = 0.05.7

Twelve kilograms of fresh okra pods were obtained from a local supermarket. The fresh okra pods were washed with tap water and seeds were discarded. They were then sent to the Institute of Pharmaceutical Sciences - National Institutes of Health at the University of the Philippines Manila for further processing. Peels were dried using an air-circulated oven at 50°C. The dried material was pulverized using a grinder then sieved under mesh

60, with a yield of about 120 g of powdered okra per 2 kg of fresh okra. The powdered material was weighed, stored in a dry and clean resealable plastic bag, and refrigerated under 4 ºC. Each okra capsule contained 0.6 g of powdered okra, while each placebo capsule contained 0.6 g of cornstarch powder. Capsules were stored in amber bottles at 4 ºC.

Each subject in the control group took 2 placebo capsules a day, amounting to only 0.04% of the recommended carbohydrate intake. The daily recommended total carbohydrate intake for ages 19-64 is 282-360 g/day.[11] Acute oral toxicity of *A. esculentus* based on a study on rats was determined at 2g/kg when converted to human toxic levels.[7] This would mean taking 100 tablets per day before reaching toxicity levels.

Subjects in the treatment group were given okra capsules and those in the control group were given placebo capsules. All subjects were then instructed to take one capsule twice a day after meals for the next 30 days. To ensure compliance, subjects were provided with a checklist and received daily text message reminders. Subjects were asked to follow up after one month for another FBS determination.

A paired t-test to compare the 30-day and baseline FBS within groups and an independent T-test was used to compare the mean difference in FBS between the okra and placebo groups. SPSS version 23 was used to process and analyze the data in this study.

Results

Forty-five patients were identified from the records and 30 fulfilled the FINRISC and FBS criteria. Six subjects dropped out for various reasons leaving 24 subjects for the analysis. Comparing the demographics between the treatment and control groups, there were no significant differences in age ($p = 0.12$), sex ($p = 0.67$), BMI ($p = 0.48$), daily physical activity for 30 min ($p = 1.00$), and daily vegetable and fruit intake ($p = 1.00$). There was no significant difference in the mean pre-treatment FBS levels between the treatment and control groups. The two groups were comparable at the time of treatment (Table 1).

Results showed a significant difference between the pre-treatment and post-treatment FBS levels, respectively, of both the okra and placebo groups (p-value <0.01). However, as seen in Table 2, the difference between the mean difference of the okra and placebo groups was not significant ($p = 0.06$).

Table 1. Sociodemographic and baseline data of 24 subjects with impaired fasting glucose.

	Okra Mean ± SD	Placebo Mean ± SD	p-value
Age	54 ± 9.9	48.3 ± 6.8	0.12
BMI	27.4 ± 2.6	26.8 ± 1.7	0.48
	n (%)	n (%)	
Sex			
Male	5 (41.7)	3 (25)	0.67
Female	7 (58.3)	9 (75)	
Physical activity			
Yes	0 (0)	0 (0)	1.00
No	12 (100)	12 (100)	
Diet			
Everyday	0 (0)	1 (8.3)	1.00
Not everyday	12 (100)	11 (91.7)	
Baseline FBS	106.1	107.3	0.54

Table 2. Comparison of mean difference between okra and placebo groups.

	Okra (mg/dL)	Placebo (mg/dL)	
Pre-treatment FBS	106.1	107.3	
Post-treatment FBS	88.5	96.8	
Mean difference	17.6	10.5	7.1
	($p < 0.01$)	($p < 0.01$)	($p = 0.06$)

Discussion

This study looked into the efficacy of okra capsules in lowering blood sugar levels among patients with impaired blood sugar level using a double-blind randomized clinical trial. The results of this study are not consistent with previous studies.[12,13] A study on obese mice subjected to a high-fat diet showed reduced blood glucose levels after administration of okra, implying that okra may serve as dietary therapy for hyperglycemia.[12] An in vitro study which measured the effects of viscous soluble dietary fibers of okra in lowering intestinal glucose absorption showed that when diffusion systems were compared to control in a concentration-dependent manner, ($p<0.05$) a potential role of viscous soluble dietary

fibers (VSDF) of okra in lowering postprandial serum glucose was demonstrated.[13] Possible confounding variables that may have affected the outcome of post-treatment FBS levels of both treatment and control groups include: 1) subject demographics, 2) drying temperatures of okra peels, 3) form of okra preparation, 4) alcohol consumption, 5) Hawthorne effect.

The data showed that the two groups were comparable at the time of the study. The decrease in post-treatment FBS levels therefore cannot be attributed to discrepancies in subject demographics. The drying temperature of the okra peels is a possible factor that affected post-treatment FBS levels. Drying okra at 60ºC significantly ($p<0.05$) increases all quality parameters, including protein, ascorbic acid, and fiber content.[14] The fiber content of dried okra (34.5%) has been shown to be higher than that of the raw okra (28.6%).[15] After drying its peels at 60ºC, the fiber content in 100g of raw okra can be increased from 6.9g to 22.3g.[16] The rich fiber content helps improve or stabilize blood glucose levels by reducing the absorption of sugar in the intestinal tract.[7] The okra used for this study was dried at 50ºC. It is possible that this temperature failed to yield a sufficient amount of fiber to make a significant impact on blood glucose levels. This may explain the insignificant decrease of post-treatment FBS levels between treatment and control groups. Different okra preparations have been shown to have varied effects on blood glucose levels. A study showed that okra juice was effective in reducing blood sugar levels in humans, suggesting its use as a simple but effective method for diabetes control; in contrast, subjects in this study were given okra powder.[16]

According to the American Diabetes Association, alcohol can cause hypoglycemia for up to 24 hours after drinking. Since subjects were not instructed to restrict their alcohol intake, the possible hypoglycemic effects of alcohol were not controlled.[17]

The FBS levels decreased significantly after treatment. Without having been advised to make lifestyle modifications, the subjects may have exhibited the Hawthorne effect: "the mere awareness of being under observation can alter the way in which a person behaves."[18] In most experimental research studies, subjects tend to modify their behavior when they are aware that they are part of an experiment.[19] The subjects in this study may have modified or improved an aspect of their lifestyle (i.e., diet and exercise) in response to the awareness of their FBS levels being observed.

The researchers used only one parameter, fasting blood sugar, to quantify the efficacy of okra. In contrast to other studies with similar objectives, this study excluded other measuring tools including OGTT and HbA1c due to financial constraints. For future studies, the use of different parameters will provide a more accurate depiction of the subjects' blood sugar levels. Purposive sampling criteria may be modified to accommodate these additions.

One study concluded that lifestyle changes were significantly more effective than metformin in reducing the incidence of type 2 diabetes.[20] To control for this confounding variable, subjects in this study were advised not to make any lifestyle changes (i.e. diet and exercise) throughout the course of treatment. This means patients were not required to make any necessary adjustments on the aspect of their usual lifestyle while taking the okra capsules. Future studies may implement closer management of lifestyle patterns before and during the course of treatment to minimize its effect on blood sugar levels.

Despite the intervention of okra capsules in this study, uncontrolled blood sugar levels may be attributed to unavoidable mental or physical stress. During times of stress, adrenal glands secrete hormones such as epinephrine and norepinephrine to help prepare the body for stress. Epinephrine is responsible for converting glycogen stores into glucose, which often leads to elevated levels of glucose in the blood.[21] For future studies, assessment of subject's complete well-being including mental and physical stress before and during the treatment phase may be taken into consideration.

This study randomly assigned subjects into two groups (treatment and control) without using demographics as deciding factor. Assigning the subjects into treatment groups based on characteristics such as age and gender may yield more pronounced effects of treatment among the different groups. Any significant findings regarding this can help specify the therapeutic effects of okra as a blood sugar lowering agent.

The present study showed that okra capsules are not efficacious in lowering blood sugar levels. Although results showed that there is a significant decrease in pre-treatment and post-treatment fasting blood sugar of both treatment and control groups, the mean difference between two groups was not

statistically significant. Evidence is still insufficient to prove the efficacy of okra capsules in decreasing fasting blood sugar; thus, warranting the need for further studies, probably using other preparations.

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