https://doi.org/10.46389/rjd-2020-1032
www.rjdnmd.org

Rom J Diabetes Nutr Metab Dis
2020; volume 27, issue 3, pages 209-213

Original Research

The Comparative Effect of Red Guava (*Psidium guajava. L.*) with Papaya (*Carica papaya*) on Blood Glucose Level of Type 2-Diabetic Patients

Zuhria Ismawanti[1]*, JB. Suparyatmo[2], Budiyanti Wiboworini[3]

[1] Department of Nutrition, Faculty of Health Science Kusuma Husada University of Surakarta, Surakarta, Indonesia
[2] Department of Clinical Pathology, Faculty of Medicine Sebelas Maret University, Surakarta, Indonesia
[3] Department of Nutrition, Faculty of Medicine Sebelas Maret University, Surakarta, Indonesia

*Correspondence to: Zuhria Ismawanti, Department of Nutrition, Faculty of Health Science Kusuma Husada University of Surakarta, Surakarta, Indonesia. E-mail: riazuhria27@gmail.com

Received: 24 March 2020 / Accepted: 19 June 2020

Abstract

Introduction: Diabetes mellitus (DM) is a metabolic disease with clinical manifestations of hyperglycemia. In DM, hyperglycemia increases free radical levels that lead to cell damage. Fruit antioxidants are used to prevent cell damaged due to their effect in suppressing lipid peroxidation and lipotoxicity. This study aimed to evaluate the effect of red guava and papaya antioxidants in reducing blood glucose levels in type 2 DM patients **Material and Methods:** This was a quasi-experimental study with a pre-test post-test control group design. Thirty-nine subjects were divided randomly into 3 groups: red guava group (282.2 gr), papaya group (302.4 gr) and control group (only given mineral water). The treatment was conducted for 14 days. The data were analyzed using the One-way ANOVA test, continued with post hoc tests. **Results:** There was a significant decrease in blood glucose level after the administration of red guava (33 g/dl) and papaya (14 g/ dl) compared to the control group ($p<0.05$), but there were no significant differences ($p> 0.05$) between red guava and papaya. **Conclusions:** It can be concluded that red guava and papaya are equally effective in reducing blood glucose levels in type 2 DM patients.

Keywords: Red guava, papaya, antioxidant, blood glucose.

Introduction

Diabetes Mellitus (DM) is a metabolic disease characterized by hyperglycemia caused by impaired insulin secretion, insulin action, or both. DM causes various chronic complications of the eyes, kidneys, nerves, and blood vessels [1-2]. After India (32.7 million), China (22.6 million) and the United States (15.3 million), Indonesia has the highest number of people with diabetes (14 million). Riskesdas shows that East Java, one of the provinces in Indonesia, has a DM prevalence of 2.5% [3]. Based on data obtained from the Jombang District Health Office, the prevalence of diabetes has increased for three consecutive years, namely in 2015 by 5.0%, in 2016 by 5.71%, and in 2017 by 6.21% [3-6].

In diabetic patients, insulin cannot work effectively so that glucose from the consumed food cannot be maximally converted into energy and glycogen, leading to elevated blood glucose levels [7].

The autoxidation process of hyperglycemia triggers the formation of free radicals. Free radicals can damage the cell membrane into lipid peroxide and cause oxidative damage. Antioxidants intake is intended to suppress lipid peroxidation. Therefore lipotoxicity can be prevented, and cell damage caused by hyperglycemia can be avoided [8]. Vitamin C is one of the antioxidants

© 2020 The Authors. Romanian Journal of Diabetes, Nutrition and Metabolic Diseases published by Sanatatea Press Group on behalf of the Romanian Society of Diabetes Nutrition and Metabolic Diseases. This is an open access article under the terms of the Creative Commons Attribution License (CC-BY-NC-ND 3.0).

that modulates insulin action in DM patients and is associated with a decrease in blood glucose levels [9].

Red guava (*Psidium Guajava Linn.*) and papaya (*Carica Papaya*) are fruits that contain various nutritional contents, including vitamin C, fiber, carbohydrates, and flavonoids [10, 11]. Guava has 87 mg of vitamin C and papaya has 78 mg per 100 grams of fruit. Vitamin C decreases insulin resistance by improving endothelial function and reducing oxidative stress [12].

The ultimate nutritional content of guava shows that it is rich in flavonoids, particularly quercetin. [13]. Quercetin can improve glucose uptake by stimulating 3T3-L1 in mature adipocytes by insulin [14]. Moreover, it can escalate insulin sensitivity by increasing tyrosine phosphorylation in the insulin receptor and extending the signaling process. Both of these mechanisms indicate that quercetin can improve insulin resistance in peripheral tissues [15].

Papaya contains saponins with hypoglycemic effects through a mechanism for increasing glucose uptake by cells, insulin release, and insulin sensitizer [16, 17]. Guava and papaya have a glycemic index of 19 and 25, respectively, which can be categorized as a low glycemic index. The low glycemic index can reduce insulin resistance and insulin levels, causing a decrease in free fatty acids that prevent the accumulation of blood triglycerides [18].

Besides being rich in nutrients, red guava and papaya are cheap, ubiquitous throughout the year. This study aimed to examine the effect of papaya and red guava in reducing blood glucose levels.

Material and Methods

Study design and patients

This was a quasi-experimental study with a pre-test post-test control design. The independent variable in this study was the administration of red guava and papaya, and the dependent variable was blood glucose levels. The study population included type 2 DM patients of the Jombang district health center. The subjects were selected by a simple random sampling method, which met the inclusion criteria: age between 45-70 years; HbA1c value greater than 7; possibility to chew fruits; smoke and alcohol-free. Subjects who used insulin or suffered from gastrointestinal/ liver/ heart diseases were excluded. The sample size calculation was done using the hypothesis test formula on the average of two independent samples.

Intervention

Thirty-nine subjects were divided into three groups: 13 subjects were treated with 282.2 grams of red guavas, 13 subjects were given 302.4 grams of papaya and 13 were treated with mineral water as a control group. The experiment was conducted for 14 days.

The fruits were consumed as a snack after breakfast and lunch. The subject's compliance in consuming the fruits was observed using a compliance form. All subjects were given counseling and leaflets about DM at the beginning of the study. Age and sex data were obtained using a questionnaire. Body mass index (BMI) was calculated using Weight/Height in kg/m^2. Food intake was collected two times during the intervention, using 24-hour food recall forms and analyzed using the Nutrisurvey software to get average energy, protein, fat and carbohydrates intake. Blood samples were taken twice, before and after the intervention by laboratory staff after subjects fasted for ± 8 hours. Fasting blood glucose levels were measured using the hexokinase method and categorized as good if the levels were between 80 and 100 mg/dl, moderate if the values were 100-125 mg/dl, and bad if the value was higher than 126 mg/dl.

Statistical analysis

The normality of data was tested using Shapiro Wilk. Differences in fasting blood glucose levels before and after intervention in each group were tested using the paired t-test. The One-way ANOVA test was used to determine the differences in blood glucose level reduction among groups and continued with the post hoc

 https://doi.org/10.46389/rjd-2020-1032 © 2020 The Authors

test to analyze which treatment was significant. This research has been approved by the Ethics Committee of the Sebelas Maret University FK No. 305/UN27.6/KEPK/2018.

Results

Only 38 subjects could be analyzed because one subject from the red guava group dropped out. The subjects were female and male, aged 45-70 years. Table 1 shows that the average energy, protein, fat and carbohydrate intake of each group had considerable variation. However, there were no significant differences between the red guava, papaya, and control groups (p>0.05).

Table 2 shows that the most significant reduction in fasting blood glucose levels occurred in the red guava group. The value of p = 0.001 (p < 0.05) meant that there was a significant difference in decreasing fasting blood glucose levels among the three treatment groups.

The post hoc test showed that there were significant differences in fasting blood glucose levels between the red guava intervention group compared to control (p = 0.000), and between the papaya intervention group and control (p = 0.000). However, the decrease in fasting blood glucose levels between red guava and papaya was not significantly different (p = 0.140). This meant that red guava and papaya were equally effective in reducing fasting blood glucose levels.

Discussion

The administration of red guava and papaya for 14 days could reduce fasting blood glucose levels in DM patients. Huang et al. showed that red guava significantly reduced hyperglycemia in STZ-induced diabetic rats [19]. Red guava could maintain insulin secretion capacity and the ability of pancreatic β cells. Antioxidant activity of red guava might have an antihyperglycemic

Table 1: Average nutrients intake.

	Intake	Red Guava Mean ± SD	Papaya Mean ± SD	Control Mean ± SD	p
Female	Energy (Kcal)	1853 ± 330	1966 ± 376	2003 ± 346	0.660
	Protein (gram)	44 ± 14	58 ± 24	52 ± 17	0.477
	Fat (gram)	100 ± 38	118 ± 31	87 ± 23	0.09
	Carbohydrates (gram)	210 ± 70	220 ± 72	228 ± 67	0.604
Male	Energy (Kcal)	2164 ± 228	2053 ± 45	2108 ± 172	0.460
	Protein (gram)	60 ± 20	56 ± 28	55 ± 19	0.966
	Fat (gram)	161 ± 21	145 ± 31	137 ± 19	0.291
	Carbohydrates (gram)	235 ± 99	220 ± 58	220 ± 89	0.977

Note: The Value of One-way ANOVA tests show the difference in the average intake of the 3 groups.

Table 2: Differences in Fasting Blood Glucose Levels (mg/dl).

Groups	Pre Mean ± SD	Post Mean ± SD	Δ Pre-post Mean ± SD	p1	Post hoc	p2
Red guava	206 ± 41	172 ± 41	33 ± 2	0.001	Red guava vs. Control	0.000
Papaya	200 ± 33	186 ± 33	14 ± 0.9		Papaya vs. Control	0.000
Control	187±38	181 ± 33	6.8 ± 5		Red guava vs. papaya	0.140

Note: p1- p value of One-way ANOVA tests; p2 - p value of post hoc tests.

effect in STZ-induced diabetic rats. Sureddi showed that papaya significantly reduced plasma glucose levels in STZ-induced alloxan diabetic rats [20]. Papaya could increase insulin secretion from pancreatic β cells and glucose absorption by tissues. Post hoc analysis showed a significant difference in decreasing fasting blood glucose levels between the red guava and control groups ($p = 0.000$), and between papaya and control ($p = 0.000$). However, fasting blood glucose levels between red guava and papaya were not different significantly ($p = 0.140$). It means that red guava and papaya were similarly effective in reducing fasting blood glucose levels, but red guava had a higher clinical effect in reducing fasting blood glucose levels. After the administration of red guava, the decrease in blood glucose level is 2.3 times greater than in papaya (33 ± 2 compared to 14 ± 0.9 g/dl, respectively).

Red guava and papaya contain vitamin C or ascorbic acid, which can affect blood glucose levels [21-24]. Vitamin C is an antioxidant, which plays an essential role in protecting against damage from free radicals. Vitamin C is structurally similar to glucose and can interchange it in many chemical reactions and effectively prevent the glycosylation of non-enzymatic proteins. Antioxidants increase β cell function in diabetes, although the effect may not be through a direct action on the β cells. Increased action of vitamin C on insulin may be due to an increase in non-oxidative glucose metabolism [12].

Red guava contains fiber and quercetin. Quercetin can reduce blood glucose levels due to its potential effect as an inhibitor of glucose transport by intestinal GLUT2 and GLUT5. These receptors are responsible for glucose absorption in the small intestine [24]. Fiber consumption has a positive effect on blood glucose levels in type 2.

DM patients. Dietary fiber delays gastric emptying time and intestinal glucose absorption. Studies on type 2 DM patients from Texas reported that a high-fiber diet would reduce blood glucose levels [21, 22].

Another beneficial content of papaya in diabetes is represented by saponins [25]. Saponins are antidiabetics through their effect of inhibiting the α-glucosidase enzyme, an enzyme that plays a role in converting carbohydrates to glucose. If the α-glucosidase enzyme is inhibited, the glucose (sugar) levels in the blood will decrease, resulting in a hypoglycemic effect (blood sugar levels decrease) [26]. Saponins are known to have hypoglycemic effects indicated by increasing glucose uptake by cells, insulin release, and effects (insulin sensitizer) [16-17]. Saponins stimulate insulin signals in diabetic mice, resulting in improved homeostasis [27]. A limitation of this study was that we did not analyze other nutrients intake that can decrease blood glucose levels.

Conclusion

Giving 282.2 grams of red guava and 302.4 grams of papaya for 14 days were equally effective in reducing blood glucose levels of type 2 diabetes mellitus patients.

Conflict of Interest

The author declares no conflict of interest.

References

1. Perkeni. *Konsensus Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 di Indonesia*. Jakarta: Perkumpulan Endokrinologi Indonesia. 2011.
2. American Diabetes Association. Classification and Diagnosis. *Diabetes Care* 36(Suppl.1): S13, 2013.
3. Riset Kesehatan Dasar. Badan Penelitian dan Pengembangan Kesehatan Kementerian Republik Indonesia. 2013.
4. Dinas Kesahatan Jombang. *Profil Kesehatan Jombang* 2015. Jombang: Dinas Kesehatan Jombang. 2015.
5. Dinas Kesahatan Jombang. *Profil Kesehatan Jombang* 2016. Jombang: Dinas Kesehatan Jombang. 2016.
6. Dinas Kesahatan Jombang. *Profil Kesehatan Jombang* 2017. Jombang: Dinas Kesehatan Jombang. 2017.
7. Departemen Kesehatan RI. *Pedoman Pengendalian Diabetes Mellitus dan Penyakit Metabolik*. Jakarta: Departemen Kesehatan RI. 2010.
8. Ali M, Al Shamma G, Hashim H. Beta Carotene, Glycemic Control and Dyslipidemia in Type 2 Diabetes Mellitus. *J Fac Med Bagdad*, 48:435–41, 2006.
9. Via M. The Malnutrition of Obesity: Micronutrient Deficiencies That Promote Diabetes. *ISRN Endocrinol* p. 1–8, 2012.
10. Krishna KL, Paridhavi M, and Patel JA. Review on Nutritional, Medicinal and Pharmacological Properties of Papaya (Carica papaya Linn.). *Indian J Nat Prod Resour* 7(4): 64–373, 2008.

 https://doi.org/10.46389/rjd-2020-1032 © 2020 The Authors

11. Yusuf AH, Efendi F, Afitasari DH. Guava Juice Reduce Cholesterol Level in Elderly Diabetes. *Journal of Ners*. Vol 5 No.1:1–19, 2016.
12. Afkhami M. & Shojaoddiny A. 2008. Effect of Vitamin C on Blood Glucose, Serum Lipids & Serum Insulin In Type 2 Diabetes Patients. *Indian J Med Res* 126.
13. Parle M and Gurditta. Basketful Benefit of Papaya. *IJRP* 2(7) 6–12. 2230-8407, 2011.
14. Eid M, Hoda S, Haddad, Pierre. The antidiabetic Potential of Quercetin: Underlying Mechanisms. *Current Medicinal Chemistry* Volume 24, Number 4pp.355–364 (10), 2017.
15. Kannappan S & Anuradha CV. Insulin Sensitizing Sction of Polyphenols, Quercetin & Metformin in a rat Model. *Indian J Med Res* pp 401–408, 2009.
16. Astuti J, ET Arung, W Suwinarti. Antioxidant Activities from Extract Leaves of Tahongai (Kleinhovia hospita Linn.). 12th. *Indonesian Wood Research Society National Seminar*, Bandung. P. E22, 2009.
17. Singh LW. Traditional Medicinal Plants of Manipur as Anti-Diabetics. *J. Med. Plants Res*, 5(5): 677–687, 2011.
18. Galisteo M, JuanDuarte, Antonio Z. Effects of Dietary Fibers on Disturbances Clustered in The Metabolic Syndrome. *The Journal of Nutritional Biochemistry* Volume 19, Issue 2, Pages 71–84, 2008.
19. Huang Y, Mei L, Lan C. Antihyperglycemic and Antioxidative Potential of Psidium Guajava Fruit in Streptozotocin-Induced Diabetic Rats. *Food and Chemical Toxicology*, 2189–2195. 2011.
20. Sureddi J, Sharma J. Evaluation of Hypoglycemic, Anti Hyperglycemic and Anti Hyperlipidemic Activity of Hydroalcholicextract of Carica Papaya L. in Alloxan Induced Diabetic Rats. *World Journal of Pharmacy and Pharmaceutical Sciences*, Volume 5, Issue 10, 1017–1030, 2016.
21. Maisarah AM, Amira BN, Asmah R, Fauziah O. Antioxidant Analysis of Different Parts of Carica Papaya. *IFRJ* J. 20 (3), 1043–1048, 2013.
22. Aravind G, Debjit B, Duraivel S, Harish G. Traditional and Medicinal Uses of Carica papaya. *J Med Plants Stud* 1 (1), 7–15, 2013.
23. Ismawanti Z, Suparyatmo JB, Wiboworini B. The Effects of Papaya Fruit as Anti Diabetes Type 2: A Review. Int J Nutr Sci. 4(2):65–70. 2019;
24. Rao M, Sreenivasulu M, Chengaiah B, Reddy KJ, Chetty CM. Herbal Medicines for Diabetes Mellitus: A Review. *J. PharmTech Res* 4(3):1883–92. 2010
25. Chukwuka KS, Iwuagwu M and Uka U. Evaluation of Nutritional Components of Carica papaya L at Different Stages of Ripening. *Int J Pharm Biol Sci* Vol 6, Issue 4, 2013.
26. Rotblatt M, Zimet I. *Evidence-based herbal medicine*. London: Haney & Belfus, INC. 2012.
27. Kwon DY, Kim YS, Hong SM, Park S. Long-term consumption of saponins derived from Platycodi radix (22 years old) Enhances Hepatic Insulin Sensitivity and Glucosestimulated Insulin Secretion In 90 % Pancreatectomized Diabetic Rats Fed A Highfat Diet. *British Journal of Nutrition*, 101(3): 358–66, 2012.