Effect of Cucumis sativus L on Glucose Absorption through Intestinal Mucosal Membrane of Wistar Rat Models

Fitri Amalia,[1] Samsudin Surialaga,[2] Sylvia Rachmayati[3]

[1]Faculty of Medicine, Universitas Padjadjaran, [2] Departement of Biochemistry, Faculty of Medicine, Universitas Padjadjaran, [3]Departement of Clinical Pathology, Faculty of Medicine, Universitas Padjadjaran/Dr. Hasan Sadikin General Hospital, Bandung

Abstract

Background: The Cucumis sativus L has been used in traditional medicine for several conditions, with one of them being diabetes mellitus. The purpose of this experiment is to observe the anti-hyperglycemic effect of Cucumis sativus L on glucose absorption through the intestinal mucosal membrane of Wistar rats.

Methods: The research was conducted on September–November 2012 at Biochemistry Laboratory, Faculty of Medicine, Universitas Padjadjaran. Using in situ perfusion method, the rat's epithelial mucosa in the intestine was bathed in a simple glucose solution in control, and bathed in glucose and Cucumis sativus L infusion in treatment. After admission, a sample was taken from the digestive tract and the glucose level was measured through a spectrophotometer.

Result: There is no significant difference in the absorption of control and treatment solution.

Conclusion: The Cucumis sativus L does not have any significant effect on the glucose absorption through the intestinal mucosal membrane. Further studies are still needed to reveal the antihyperglycemic mechanism of Cucumis sativus L.[AMJ.2014;1(1):30–4]

Keywords: Antihyperglycemic effect, Cucumis sativus L (Cucumber), Diabetes mellitus, Glucose absorption.

Pengaruh Cucumis sativus L pada Penyerapan Glukosa melalui usus mukosa Membran Tikus Wistar

Abstrak

Latar Belakang: Buah timun (Cucumis sativus Linn.) telah dipercaya sebagai obat tradisional beberapa penyakit, salah satunya adalah diabetes melitus. Penelitian ini ditujukan untuk mengetahui efek antihiperglikemi buah timun terhadap transpor glukosa melalui sel epitel mukosa usus halus tikus wistar.

Metode: Dengan menggunakan metode perfusi *in situ,* usus halus tikus dialiri larutan glukosa selama 60 menit untuk kontrol dan larutan glukosa yang telah diberi infusa timun selama 60 menit untuk perlakuan. Sampel yang diambil berupa cairan yang dialirkan ke usus pengambilan dilakukan pada menit ke 0, 15, 30, 45, 60, kemudian dilakukan pengukuran kadar glukosa dengan menggunakan spektofotometri. Penelitian ini dilakukan pada September–November 2012 di Laboratorium Biokimia, Fakultas Kedokteran, Universitas Padjadjaran

Hasil: Tidak terdapat perbedaan bermakna antara penyerapan glukosa pada larutan kontrol dengan larutan perlakuan.

Simpulan: Cucumis sativus L tidak memiliki pengaruh yang signifikan terhadap penyerapan glukosa melalui membran mukosa usus. Penelitian lebih lanjut masih diperlukan untuk mengetahui mekanisme anti hyperglycemic Cucumis sativus L.

Kata kunci: Cucumis sativus L (Cucumber), diabetes mellitus, efek antihyperglycemic, penyerapan glukosa .

Correspondence: Fitri Amalia, Faculty of Medicine, Universitas Padjadjaran, Jalan Raya Bandung-Sumedang Km.21, Jatinangor, Sumedang, Indonesia, Phone: 081280929465, Email: fitri.ahermanto@gmail.com

Introduction

Diabetes mellitus is a metabolic disorder with an increase in blood glucose above the normal level (random blood glucose ≥200 mg/dl).[1] According to World Health Organization (WHO) in 2011, 346 million people suffer from this disease globally. In Indonesia, it is predicted by 2030 the prevalence of this disease would be around 21,3 million people.[2]

Uncontrolled diabetes mellitus may cause a serious complications that lead to death. In 2004, approximately 3.4 million people died because of hyperglycemia. During the period of 2005–2030 it is predicted that mortality caused by diabetes mellitus would have doubled.[3] To reduce the mortality and morbidity in diabetes mellitus, the treatment focuses on reducing the hyperglycemia. This can be achieved by maintaining a healthy diet, regular exercise, and consuming oral antidiabetic drugs.[1] In addition to conventional therapy herbal medicine has shown the effect to control diabetes mellitus.[4]

Cucumber (Cucumis sativus L) is believed to be originating from a wild plant in India. Cucumis sativus L contains a lot of phytochemicals that show many pharmacological activities, among them are hypoglycemia and antimicrobial agents.[5] A study on diabetic and normal rats shows a significant reduction in blood glucose after 9 days of oral Cucumis sativus L extract daily therapy.[6] Another study in rats shows that Cucumis sativus L is effective to prevent alloxan- induced hyperglycemia.[7] Although previous studies have demonstrated that Cucumis sativus L has an antihyperglycemic effect on blood glucose, the exact mechanism of how it works is still unknown. Therefore, this study was conducted to observe the antihyperglycemic effect of Cucumis sativus L on the glucose absorption in the small intestine.

Methods

The Cucumis sativus L was purchased from local market at Jatinangor and was identified by Department of Biology, Faculty of Mathematics and Natural Science, Universitas Padjadjaran. The fruit was cut into small pieces, then it was added into an infusion pot with the same proportion of aquadest to create an infusion.[8]

Five healthy male Wistar rats, 3–4 months old (150–250 gr) were fasted overnight and allowed access to water ad libitium. One week before the experiment, the rats were adapted. The rats that died from the adaptation process were excluded from the experiment.[8,9] The Health Research Ethics Committee, Faculty of Medicine, Universitas Padjadjaran has reviewed this research and guaranteed that the research would follow guidelines of the International Conference on Harmonisation-Good Clinical Practice (ICH-GCP).

This research used in situ perfusion method which enables the intestine to function normally for 6–8 hours.[10] Overnight fasted rats received intramuscular anesthetic injection using Ketamin 0.1 ml/100 gr body weight. There were two treatments that were given, first a 25 ml glucose solution for 60 minutes, then a 25 ml glucose solution added with 1 ml Cucumis sativus L infusion for another 60 minutes. Every 15 minutes, a 2 ml sample was taken from the remaining solution.[10]

Trichloroacetic acid (TCA) 8,0% was used to deproteinized the samples, which were then centrifuged at 3000 rpm for 10 minutes. The supernatants were mixed with glucose reagent and incubated in the waterbath at 37°C for 10 minutes. The absorbancy of the samples was read using a spectophotometer at 500 nm wave length.[10]

The data distributions were checked using Saphiro-Wilk normality test and were analyzed by paired t-test using Statistical product and service solution (SPSS) 15 software. The results were considered statistically significant if the p-values were <0.05.11

Result

The glucose absorptions of solution I (glucose

Table 1 Glucose Means

Rat	Solution I (mg/dl)	Solution II (mg/dl)
1	6.83	2.06
2	14.09	15.9
3	7.27	13.27
4	18.38	28.47
5	18.88	22.35
Mean	13.09	16.41

Note: Solution I=glucose solution (mg/dl), Solution II=glucose solution and Cucumis sativus L infusion (mg/dl)

Table 2 Remaining and Absorbed Glucose Concentration from Solution I

Rat	Time (minutes)	Absorbancy means	Glucose that remains (mg/dL)	Glucose that were absorpted (mg/dL)
1 (222.4 g)	0	0.181	65.10	
	15	0.120	43.16	21.94
	30	0.120	43.16	0.00
	45	0.117	42.08	1.08
	60	0.105	37.77	4.31
Mean			46.25	6.83
2 (241.3 g)	0	0.314	114.18	
	15	0.188	68.36	45.82
	30	0.175	63.63	4.73
	45	0.159	57.81	5.82
	60	0.159	57.81	0.00
Mean			72.35	14.09
3 (232.8 g)	0	0.230	83.63	
	15	0.200	72.72	10.91
	30	0.164	59.63	13.09
	45	0.152	55.27	4.36
	60	0.150	54.54	0.73
Mean			65.15	7.27
4 (235.4 g)	0	0.302	111.02	
	15	0.190	69.85	41.17
	30	0.167	61.39	8.46
	45	0.123	44.72	16.67
	60	0.102	37.50	7.22
Mean			64.89	18.38
5 (235.7 g)	0	0.312	113.86	
	15	0.187	68.24	45.62
	30	0.160	58.39	9.85
	45	0.116	42.33	16.06
	60	0.105	38.32	4.01
Mean			64.22	18.88

solution) and solution II (glucose solution and Cucumis sativus L infusion) were summarized in Table 1. The result of the comparison meant that in solution I and II glucose absorption shows that there is no statistically significant between the two ($p > 0.05$).

From 5 rats, 4 of them showed the highest glucose absorption on the first 15 minutes (Table 2).

The rat number 3 and 4 have the highest glucose absorption on the first 15 minutes, while the rat number 2 has the highest on the last 15 minutes, and rat number 4 on the second 15 minutes (Table 3)

Table 3 Remaining and Absorbed Glucose Concentration from Solution II

Rat	Time (minutes)	Absorbancy means	Glucose that remains (mg/dL)	Glucose that were absorpted (mg/dL)
1 (222.4 g)	0	0.126	45.32	
	15	0.121	43.52	1.80
	30	0.119	42.80	0.72
	45	0.111	39.92	2.88
	60	0.103	37.05	2.87
Mean			42.08	2.06
2 (241.3 g)	0	0.268	97.45	
	15	0.254	92.36	5.09
	30	0.232	84.36	8.00
	45	0.204	74.18	10.18
	60	0.177	64.36	40.33
Mean			82.54	15.90
3 (232.8 g)	0	0.293	106.54	
	15	0.197	71.63	34.91
	30	0.154	56.00	15.63
	45	0.151	54.90	1.10
	60	0.147	53.45	1.45
Mean			68.50	13.27
4 (235.4 g)	0	0.400	147.70	
	15	0.269	98.89	48.81
	30	0.184	67.64	31.25
	45	0.109	40.00	27.64
	60	0.092	33.82	6.18
Mean			77.61	28.47
5 (235.7 g)	0	0.329	120.07	
	15	0.268	97.81	22.26
	30	0.165	60.21	37.60
	45	0.096	35.03	25.18
	60	0.084	30.65	4.38
Mean			68.75	22.35

Disscussion

The results from the analysis in Table 1 show that there is no statistically significant difference between the glucose absorption in solution I and II. It suggested that this may be due to some possibilities including the possibility that the antihyperglycemic effect of Cucumis sativus L involves a different process of glucose metabolism, such as by decreasing plasma glucagon, and that the antihyperglycemic effect of Cucumis sativus L is only effective after a prolonged treatment.[6]

From this experiment, it can be concluded that Cucumis sativus L does not have any significant effect on glucose absorption

through the intestinal mucosal membrane. Further studies are still needed to understand the antihyperglycemic mechanism of Cucumis sativus L .

References

1. Fauci AS, Weiner C, Braunwald E, Kasper DL, Hauser SL, Longo DL, et al. Harrison's Value Pack 17th ed. New York: McGraw-Hill; 2008. p. 2277, 2282.
2. Departemen Kesehatan Republik Indonesia. Tahun 2030 prevalensi diabetes melitus di Indonesia mencapai 21,3 juta orang. Jakarta: 2009 [cited 2012 April 30]; Available from: http://www.depkes.go.id/index.php/berita/press-release/414-tahun-2030-prevalensi-diabetes-melitus-di-indonesia-mencapai-213-juta-orang.html.
3. World Health Organization. Diabetes. 2011 [cited 2012 April 30]; Available from: http://www.who.int/mediacentre/factsheets/fs312/en/index.html.
4. Khan A, Safdar M. Role of diet, nutrients, spices, and natural products in diabetes mellitus. Pak J Nutr. 2003;2(1):1–12.
5. Lim TK. Edible medicinal and non-medicinal plants: volume 2, fruits. New York: Springer; 2012. p. 239–47.
6. Minaiyan M, Zolfaghari B, Kamal A. Effect of hydroalcoholic and buthanolic extract of cucumis sativus seeds on blood glucose level of normal and streptozotocin-induced diabetic rats. Iran J Basic Med Sci. 2011;14(5):436–42.
7. Dixit Y, Kar A. Protective role of three vegetable peels in alloxan induced diabetes mellitus in male mice. Plant Foods Hum Nutr. 2010;65(3):284–9.
8. Ehrhardt C, Kim KJ. Drug absorption studies: in situ, in vitro and in silico models. New York: Springer; 2008. p. 48–50.
9. WHO. Research guidelines for evaluating the safety and efficacy of herbal medicines. Manila: World Health Organization Regional Office for the Western Pacific; 1993. p. 38.
10. Achmad S. Mechanism of membrane transport. Jatinangor: Universitas Padjadjaran; 2006. p. 1–4.
11. Dahlan MS. Statistik untuk kedokteran dan kesehatan. 4th ed. Jakarta: Salemba Medika; 2009. p. 60.