The Influence of Mung Bean And Ginger Extracts Combination on Blood Glucose Levels of Type-2 Diabetes Mellitus Rats Model

Shanti Listyawati(✉), Elisa Herawati, and Tetri Widiyani

Biology Department, Faculty of Mathematics and Sciences, Universitas Sebelas Maret Surakarta, Surakarta, Indonesia
shantilistyawati@staff.uns.ac.id

Abstract. Mung bean (*Vigna radiata*) is a nutrient-rich food with a low glycemic index, which is generally served in the form of drinks with various flavors. This study aims to examine the effectiveness of mung bean combined with a ginger (*Zingiber officinale*) extract which contains anti-inflammatory ingredients and also improves the taste of the drink on blood glucose levels in type-2 diabetes mellitus (T2DM) rats model. This experimental study used a rat model (*Rattus norvegicus*) of T2DM. They were divided into three treatment groups and each consisted of 5 rats. Glucose levels were measured post-prandial and 4 weeks after extract intervention. The data were analyzed by ANOVA and Tukey's post hoc. The results showed that a combination drink of mung bean and ginger extract could control blood glucose levels, the same as a commercial T2DM diet drink.

Keywords: *Mung bean · ginger · diabetes mellitus*

1 Introduction

Type 2 diabetes mellitus (T2DM) is a type of diabetes mellitus. The main characteristic is insulin resistance, or the pancreas does not have enough production of insulin so manifestation increases blood glucose, obesity, dyslipidemia, and hypertension [1]. According to WHO data, the growth in the number of T2DM patients reaches 90–95% of DM cases, so it becomes an international health concern. This disease is also closely related to the inflammatory response. The release of inflammatory factors can cause pancreatic damage including β-cell so insulin synthesis and secretion are disrupted [3]. Most of the treatment for T2DM is to lower blood glucose levels by stimulating insulin secretion and increasing insulin sensitivity in target cells [3, 4]. T2DM patients should always take medication to control their blood glucose levels. On the other hand, continuous drug consumption can cause side effects, such as nausea, dizziness, and hypoglycemia. To overcome this, recently many explorations of dietary sources have been developed that can control blood glucose levels but has minimal side effects. One that has the potential to be developed is a combination of mung bean (*Vigna radiata*) and ginger (*Zingiber officinale*) extracts.

M. Fadilah et al. (Eds.): IcoBioSE 2021, ABSR 32, pp. 475–480, 2023.
https://doi.org/10.2991/978-94-6463-166-1_57

Ginger is a type of plant in the Zingiberaceae family, ginger rhizome contains many bioactive compounds. The main compounds in ginger rhizome are essential oils, gingerols, and diarylheptanoids [5]. Previously studies have revealed various biological effects of ginger, including the anti-obesity effect in ginger supplementation in vivo. Ginger supplementation in mice induced by a high-fat diet can reduce body weight, hyperglycemia, hyperlipidemia, and down-regulate expression of the adipocyte inflammatory gene [6]. For this reason, this study examines the influence of the mung beans and ginger combination on blood glucose levels in the type-2 diabetes mellitus (T2DM) rats model.

2 Material and methods

2.1 Materials

Mung bean was purchased from the market in Surakarta-Indonesia, and the ginger powder was purchased from BBPTOOT (Balai Besar Penelitian dan Pengembangan Tanaman Obat dan Obat Tradisional Tawangmangu, Jawa Tengah, Indonesia), Streptozotocin (SIGMA-USA), Glucodiab Drink (SOHO Global Health).

2.2 Preparation of Extract

Mung beans premium quality 200g soaked in water at 25 °C for 24 h, then boiled in 4L boiling water with ginger powder (15%) for 1 h until soft, then blended and filtered. This filtrate is used as a treatment material. This formulation is the best formulation of organoleptic and hedonic tests in previous studies.

2.3 Animals and Experimental Design

This study used 15 male white rats (*Rattus norvegicus*) Wistar strain (4 weeks old) with an average body weight of 200–220 g. Animal treatment has been approved by the Health Research Ethics Committee, Faculty of Medicine, The University of Muhammadiyah Surakarta with the number: 4034/A.1/KEPK-FKUMS/I/2022.

The animals were acclimated for 1 week at room temperature (24 ± 2 °C), relative humidity (45 ± 3%), and light (12 h/12 h light/dark), food and drink water were given ad libitum. After acclimatized, rats were then given a high-fat diet (a mixture of standard feed, lard oil, and egg yolk) for 4 weeks then injected with streptozotocin (30 mg/Kg BW in 0.1 Citrate–buffered saline pH 4.5 intraperitoneally. After 1 week, the blood glucose level was measured. The T2DM rats model successfully was characterized by blood glucose levels of more than 200mg/dL.

The rat model was randomly divided into 3 groups, i.e. the negative control group (orally aquades), and group 2 was an intervention of a combination of both extract, and positive control (Glucodiab drink). On the first day, the animal model fasted for 6 h and then get intervention according to the treatment of each group, the glucose level of postprandial data was measured at 0, 60, and 120 min after gavage. Then the treatment was continued for 4 weeks. At the end of the treatment, blood glucose levels were measured too. Data were analysis by ANOVA and post hoc Tukey-Test.

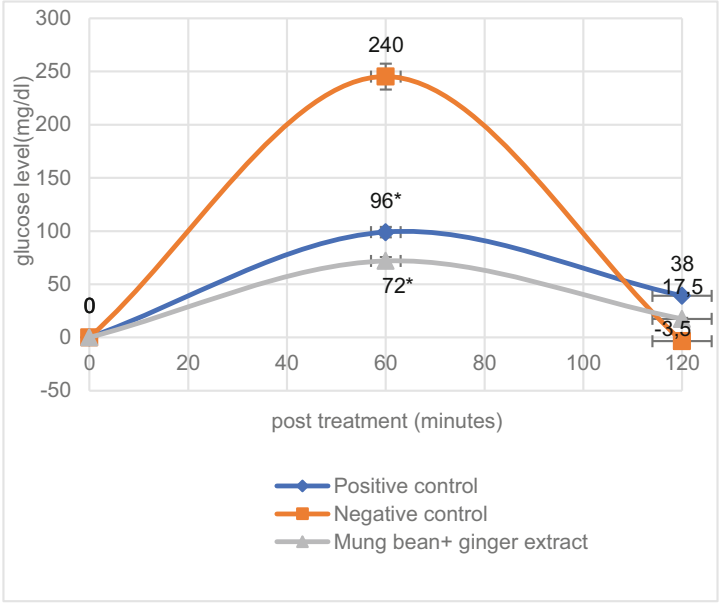

Fig. 1. Effect the combination of mung bean and ginger extract on the post-prandial blood glucose

3 Results and Discussion

Post-prandial glucose levels are blood glucose levels measured after a meal. In this study, post-prandial glucose levels were measured at 60 and 120 min after extract intervention. Figure 1 shows, after 60 min of treatment, there was an increase in glucose levels. The negative control group (T2DM rats) experienced the highest increase, which was 240mg/dL, while the group with the intervention with dietary supplementation of extract combination was 72 mg/dL, this was the same effect($p < 0,05$) as the positive control group that received commercial anti-diabetic drink (96 mg/dL). Moreover, the dietary supplementation of the combination of mung bean and ginger extract could decrease the peak of post-prandial glucose level, which 60% was lower than the negative control group.

In the negative control group, feed consumption will produce glucose faster than other groups, and insulin resistance causes glucose to be transported more slowly into cells than normal animals, so that blood glucose levels will fast increase. The high dietary fiber in mung beans causes carbohydrates to be digested longer [5]. In this regard, mung bean has characteristics that support it as an antihyperglycemic, that were low glycemic index and a high amylose-amylopectin ratio, that has an impact on post-prandial glucose response [13]. Both of these characteristics cause the digestion of carbohydrates to be slower so that blood glucose levels can be controlled. At the same duration of digestion, the group with diet supplementation with combination mung bean and ginger extract produced glucose levels lower than the negative control group. The positive control group received treatment containing compounds that were proven to increase glucose transport into cells to control postprandial blood glucose levels. The other bioactive components

Table 1. The effect of daily intervention of combination mung bean and ginger extract for 4 weeks on blood glucose levels

Treatment Group	Effectiveness to decreased blood glucose levels (%)
Negative control	4.17 ± 2.11
Positive control	45.50* ± 5.46
The extract combination	58.83* ± 6.72

* its not significantly different p = 0.05

in mung bean have also been reported to improve blood glucose levels in T2DM models. The content of phenolics, flavonoids, and active peptides in mung bean could inhibit the activity of enzymes such as alpha-amylase and alpha-glucosidase. In addition, mung bean water extract also showed antioxidant activity as indicated by increased superoxide dismutase activity, and decreased mitochondrial ROS and MDA [14].

The daily intervention of the extract combination for four weeks resulted glucose levels were lower than normal animals and significantly different from the negative control group, but not different from the positive control group (Table 1).

The intervention of extract combination for 4 weeks can decrease blood glucose levels of animal models by 58.83% (Table 1), this effect is not significantly different from the positive control group. This shows that the combination of mung bean and ginger extracts can control glucose levels equivalent to antidiabetic drinks that have been produced commercially. The results are in agreement with several previous studies, ginger significantly lowers blood glucose and improves lipid profile in hyperglycemic rat models [5–8] and reduced of expression of adipocyte inflammatory gens. The hypoglycemic effect occurs through the mechanism of inhibition of enzymes that function in complex carbohydrate metabolism (glucosidase and α-amylase). [9]. Besides, the component of ginger, there are 6-Gingerol and 6-Paradol and 6-shogaol, could to stimulate glucose metabolism via the AMPK alpha2-mediated AS160-Rab5 pathway and through potentiation of insulin-mediated glucose regulation [10]. The ginger extract could also up regulate the expression of glucose transporter type 4 (GLUT-4) and GLUT-4 to promote glucose uptake in adipocyte and skeletal muscle cells [11]. Moreover, 6-Gingerol extracted from ginger have a cytoprotective effect on pancreatic β-cells [12]. This study showed that the combination of mung bean and ginger extracts had a synergistic effect on controlling blood glucose levels in rat models.

4 Conclusion

The combination of mung bean and ginger extracts can decrease post-prandial glucose spikes and blood glucose levels after daily consumption for four weeks. This combination of extracts has the potential as a dietary supplement for treatment of T2DM.

Acknowledgments. This research was supported by RKAT PTNBH Universitas Sebelas Maret, with Research Assignment Agreement Number: 254/UN27.22/PT. 01.03/2022.

Author's Contribution. SL and TW designed and performed the experiments, derived the models and analysed the data. EH and SL wrote the manuscript.

References

1. S.E. Kahn, The relative contributions of insulin resistance and beta-cell dysfunction to the pathophysiology of type 2 diabetes, Diabetologia*,* vol. 46, 2003, p. 3–19.
2. R.A. DeFronzo, E. Ferrannini, L. Groop, R.R. Henry, W.H. Herman, J.J. Holst, Type 2 diabetes mellitus, *Nat Rev Dis Primers.* 1:15019, 2015. doi:https://doi.org/10.1038/nrdp. 2015.19 S
3. K. Yang, K.H. Lauritzen, M.B. Olsen, T.B. Dahl, T. Ranheim, M.S. Ahmed, Low cellular NAD compromises lipopolysaccharide-induced inflammatory responses via inhibiting TLR4 signal transduction in human monocytes, J Immunol*,* vol. 203, 2019, p:1598–608, doi: https://doi.org/10.4049/jimmunol.1801382
4. M. Tumvoll, B.J. Goldstein, T.W. Van Haeften, Type 2 diabetes: principles of pathogenesis and therapy. *Lancet.* 365, 2005 p:1333–1346, doi: https://doi.org/10.1016/S0140-6736(05)61032-X
5. Y. Liu, J. Liu, Y. Zhang, Research Progress on Chemical Constituents of *Zingiber officinale* Roscoe. *BioMed Research International*, 2019.
6. Seo, Eh, F. Fang, I. Kang, Ginger (*Zingiber officinale*) Attenuates Obesity and Adipose Tissue Remodelling in High-Fat Diet Fed C57BL/6 Mice, *Int J Environ Res Public Health.* **18**(2), 2021, p: 631
7. H.R Madkor, S.W. Mansour, and G. Ramadan, Modulatory effects of garlic, ginger, turmeric and their mixture on hyperglycaemia, dyslipidaemia and oxidative stress in streptozotocin-nicotinamide diabetic rats, *British Journal of Nutrition*, vol. 105 (80), 2011, p: 1210–1217, https://doi.org/10.1017/S0007114510004927. 2011
8. N.S. Mashhadi, R. Ghiasvand, G. Askari, M. Hariri, L. Darvishi, M.R. Mofid, Anti-Oxidative and Anti-Inflammatory Effects of Ginger in Health and Physical Activity: Review of Current Evidence, *International Journal of Preventive Medicine*, Supplement of the 8th S 36, 2012. Iranian International Sports Medicine Congress
9. M.P. Rani, K.P. Padmakumari, B.O. Sankarikutty O.L. Cherian, V.M. Nisha, and K.R. Raghu, Inhibitory potential of ginger extracts against enzymes linked to type 2 diabetes, inflammation and induced oxidative stress, *International Journal of Food Sciences and Nutrition*, 62(2), 2011,p:106–110, https://doi.org/10.3109/09637486.2010.515565
10. O.J. Lee, N. Kim, H.J. Lee, Gingerol affects glucose metabolism by dual regulation via the ampkα2-mediated as160- rab5 pathway and ampk-mediated insulin sensitizing effects. *Journal of Cellular Biochemistry*, 116(7), 2015. p:1401–1410. https://doi.org/10.1002/jcb.25100
11. L. Li, Y. Tian, Y. Yeng, S. Zhang, Y. Jiang, Y. Zhang, Y. Zhan, C.Wang, Improvement in Mung Bean Peptide on High-Fat Diet-Induced Insulin Resistance Mice Using Untargeted Serum Metabolomics, *Frontier Nutrition* 9, 2022. Article 893270
12. P.B. Naidu, V.V.S. Uddandrao, R.R. Naik, Ameliorative potential of gingerol: Promising modulation of inflammatory factors and lipid marker enzymes expressions in HFD induced obesity in rats, *Molecular and Cellular Endocrinology*, Vol. 419, 2016, p: 139–147 https://doi.org/10.1016/j.mce
13. W. Ren, A.Z. Zhang, N. Jiang, S.Zhu, F.F. Zhao, Q. Wu, W. Liu, L.X. Wang, P. Cai, F.M. Wang, 2015 Effects of different amylose to amylopectin ratios on serum indices related to glucose metabolism and glucose transporter expression in fattening lambs. *Animal Feed Sci. Technol,* Vol *202, 2015, p*: 106–111

14. D. Hou, L. Yousaf, Y. Xue, J. Hu, J. Wu, N. Feng, Q. Shen, Mung Bean (Vigna radiata L.), Bioactive Polyphenols, Polysaccharides, Peptides, and Health Benefits, *Nutrien 11*, 1238. 2019, doi:https://doi.org/10.3390/nu11061238