JPPIPA 9(6) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Usage of a Senggani Fruit Vinegar (*Melastoma Affine* D. Don), to Improve Feed Efficiency and Lower Blood Glucose Levels in Hyperglycemia white Rats (*Rattus Norvegicus* L.)

Safrida[1]*, Raissya Adinda[1], Muhibbudin[1], Khairil[1], Asiah M.D[1], Fitrah Asma Ulhusna[1]

[1] Biology Education Department, Faculty of Teacher Training and Education, Universitas Syiah Kuala, Indonesia

Received: March 3, 2023
Revised: June 3, 2023
Accepted: June 25, 2023
Published: June 30, 2023

Corresponding Author:
Safrida
saf_rida@usk.ac.id

DOI: 10.29303/jppipa.v9i6.3418

Abstract: Pancreatic beta cells may suffer harm as a result of hyperglycemia. This study examined the effect of Senggani fruit vinegar on blood sugar levels in hyperglycemic white rats. Conditions associated with hyperglycemia may result in an abundance of free radicals, a lack of antioxidants, and damage to pancreatic beta cells. One category of reactive oxygen species (ROS) are the free radicals produced by hyperglycemia. Because the senggani fruit's flavonoids have strong antioxidant properties, they can reduce blood sugar levels. Using a completely randomized design, which was divided into 6 treatments and 4 repeats, this research was applied to the experimental approach. The Variant Analysis algorithm was used to analyze the study's data (ANOVA). Blood glucose levels were among the variables measured. gathered information that explains how giving rats vinegar made from the senggani fruit lowers their blood sugar levels. It is evident that the administration of senggani fruit vinegar (*Melastoma affine* D. Don) has a positive impact on lowering blood glucose levels in hyperglycemia in white rats (*Rattus norvegicus* L.).

Keywords: Blood glucose; Senggani fruit vinegar; Rats.

Introduction

A high amount of glucose in the blood that is over the normal range is known as hyperglycemia and is brought on by the pancreas' inability to create enough insulin or the body's inability to properly use the insulin that has been produced (Hardoko et al., 2020). A hormone produced by the pancreas called insulin controls how and where glucose is used and stored, hence lowering blood sugar levels (Hardianto, 2020).

Conditions associated with hyperglycemia may result in an abundance of free radicals, a lack of antioxidants, and damage to pancreatic beta cells (Irdalisa et al., 2015). Reactive oxygen species (ROS) include free radicals, which are a result of hyperglycemia (Ajie, 2015). An increase in reactive oxygen species (ROS) as free radicals damages pancreatic beta cells, which leads to less insulin hormone release and insulin resistance (Zatalia et al., 2013).

One of the plants that the people of Aceh have traditionally used to treat diabetes is the senggani plant (*Melastoma affine* D. Don). Senggani plants can thrive as wild plants. The availability and abundance of senggani plants are easy to obtain in the Aceh region. Senggani plants contain bioactive compounds that are beneficial to health.

The flavonoids in senggani fruit have strong antioxidant properties, they can lower blood glucose levels (Darliana, 2011). Quercetin, a flavonoid found in senggani fruit, shields pancreatic beta cells from harm from the environment (Singh, 2014). As an electron donor, flavonoids' antioxidants serve to stabilize free radicals (Roslen, 2014).

The most crucial component in ensuring an animal's development and survival is food (Al-Ishaq, 2019). Artificial feed is food that has been created using multiple different types of basic materials on purpose (Kamalakannan, 2016). Excellent artificial feed is food

How to Cite:
Safrida, S., Adinda, R., Muhibbudin, M., Khairil, K., Asiah, M.D., & Ulhusna, F. A. (2023). Usage of a Senggani Fruit Vinegar (Melastoma Affine D. Don), to Improve Feed Efficiency and Lower Blood Glucose Levels in Hyperglycemia white Rats (Rattus Norvegicus L.). *Jurnal Penelitian Pendidikan IPA*, *9*(6), 4338–4342. https://doi.org/10.29303/jppipa.v9i6.3418

that is easy for animals to digest, includes necessary nutrients, and has a flavor they enjoy (Agustono, 2019).

Senggani plants have the potential to be employed as vinegar in light of literature evidence indicating that fruit vinegar consumption effectively combats a number of ailments, including cancer, hyperglycemia, and bacterial (Ousaaid et al., 2021). Acetic acid included in fruit vinegar has the ability to treat rats with hyperglycemia (Putra et al., 2020). In insulin-resistant individuals, fruit vinegar increases cell sensitivity to insulin while decreasing disaccharidase activity (Putra et al., 2020). It is well known that this impact is comparable to the effects of common medications like metformin and acarbose (Putra et al., 2020).

Method

Method and Research Type

This research used an experimental method with using a completely randomized design (CRD) including 6 treatments and 4 repetitions. The treatments in this study were: N (normal), KN (hyperglycemia), KP (hyperglycemia + glibenclamide), P1 (hyperglycemia + 1 mL/kg BW Senggani fruit vinegar), P2 (hyperglycemia +2 mL/kg BW fruit vinegar senggani), P3 (hyperglycemia + 3 mL/kg BW of senggani fruit vinegar)

Location And Timing of The Study

The Biology and Chemistry Laboratory of the Faculty of Teaching and Education at the University of Syiah Kuala produces Senggani fruit vinegar. Blood glucose levels were monitored in the Experimental Animal Laboratory of Syiah Kuala University's College of Veterinary Medicine. The research was carried out between April and July 2022.

Priocedure of Senggani Fruit Vinegar

250 grams of senggani fruit combined with 750 ml of water and 50 grams of sugar. To obtain the filtrate or fruit juice, the mixture is mixed and then filtered. After that, it underwent a 15-minute, 650C pasteurization. After that, pasteurized fruit juice containing up to 1% of the sample weight (250/100 = 2.5 grams) of Saccharomyces cerevisiae was added. 10 days at ambient temperature and anaerobic conditions for fermentation (without air). 15% Acetobacter aceti was added on the eleventh day. The filtrate was kept in aerobic storage for 28 days. The fermentation's end product, fruit vinegar, is ready to use (Hardoko et al., 2020).

Procedure of Treatment Rat (Rattus norvegicus L.) Hyperglycemia

Male white rats that were hyperglycemic served as the study's experimental animals. These rat fall within the wistar strain classification. Six groups of experimental animals were created at random. There were 4 white rats in one group. Cages were used to contain the mice. The cage is initially disinfected by being sprayed with alcohol. Rat were kept in a room with a 25°C temperature. During seven days, rats were acclimated to the environment.

Glucose checks were also carried out on the first day after acclimatization to ensure all mice were in good health. Normal rat blood glucose levels range from 50-135 mg/dL (Hardoko et al., 2020). White rats experience a condition of hyperglycemia when fasting blood glucose levels ≥135 mg/dl. After all white rats were checked for blood glucose levels, only then were they induced by alloxan at a dose of 150 mg/kg BW intraperitoneally. Then the blood glucose level was checked again 72 hours after alloxan induction. Measuring blood glucose levels using a glucose test tool. The stick is inserted into the gluko test kit. Blood samples from each rat were taken from the lateral vein of the white rat's tail. Previously performed sterilization of the tail with alcohol. Then, massage the tail while being pricked with a needle, until the blood drips out. Then the blood sample is put into the stick by attaching it to a special part of the stick that absorbs blood. Then a number appears on the gluco test which shows the amount of white rat blood glucose levels. Checking blood glucose levels and weighing the rats body weight was carried out once a week on day 0, day 7, day 14, day 28.

Procedure of Measuring Blood Glucose in Rats

Use a gluco test device to check blood glucose levels. One inserts the strip into the gluco test. Each rat had blood drawn from its lateral tail vein, which is found on the white rat. Alcohol sterilization of the tail was previously conducted. Then, while being poked with a needle, rub the tail until blood begins to drip out. After that, the blood drop is placed on a blood-absorbing strip. The glucose test then yields a result. Once a week, the rats' bodies were routinely weighed and their blood glucose levels were checked.

Procedure of Efficiency of Feed

Formula for feeding: Average per group x 10%: 2 (morning and evening feeding times) x the number of rats in the group formula for edible yield: Total amount of feed - Remaining amount of feed.

Data Analysis

Once the data collected during the treatment of blood glucose in the blood of white rats within 28 days had produced its results. The graph indicates that data is collected once per week. Also, a statistical test of variance analysis (ANOVA) and test Duncan.

Result and Discussion

The analysis of the 28-day data revealed that there were variations in the average for each therapy. Figure 1 depicts mouse blood glucose during various treatments during the first, second, third, and fourth weeks of life. It also includes mouse blood glucose following an alloxan injection.

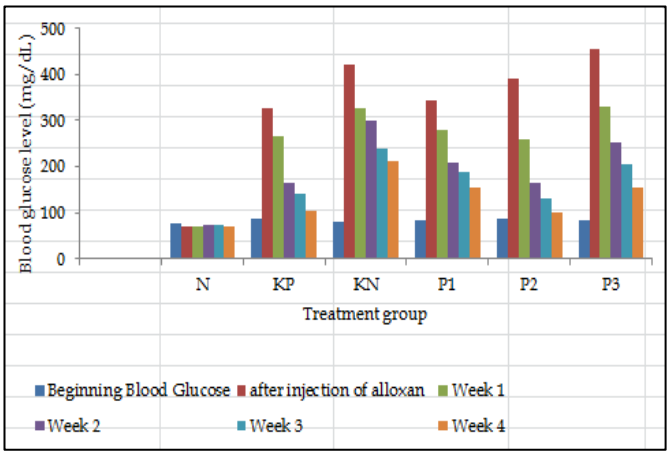

Figure 1. Average for threapy.

According to studies that have been done, the typical rat blood glucose level is 72 mg/dL. The average blood sugar level of the negative control, which simply received an alloxan injection, was 335 mg/dL. Also, the average value for the KP group (positive control was given glibenclamide), KN group (negative control was given alloxan), and P1 group (senggani fruit vinegar 1 mL/kg BW) was 102.75 mg/dL, 213.75 mg/dL, and 154 mg/dL respectively. P2 (senggani fruit vinegar 2 mL/kg BW) had a P3 level of 156.25 mg/dL, while P2 had a P3 level of 102 mg/dL. This is consistent with Hardoko's (2020) assertion that the normal group's blood glucose levels fall between 50 to 135 mg/dL. Alloxan administration caused a rise in blood sugar in the test animals' group. When blood glucose levels are between 150 and 200 mg/dL, it is considered mild hyperglycemia; between 200 and 400 mg/dL, it is moderate hyperglycemia; and above 400 mg/dL, it is severe hyperglycemia (Lenzen et al., 1996). Haryoto (2016) asserts that alloxan-induced damage to pancreatic beta cells in rats was particular. This may cause the hormone insulin, which controls blood sugar, to secrete less often (Dewi, 2020).

Rat were used as test subjects in this investigation, and hyperglycemia was induced (Irdalisa, 2015). By administering an alloxan-based diabetogenic compound to rats, hyperglycemia can be induced. A particular kind of chemical known as alloxan is harmful to pancreatic beta cells (Haryato, 2016). When blood glucose levels rise, the body's level of free radicals also rises. Reactive oxygen species (ROS) can emerge if there are more free radicals than antioxidants in the body, according to (Haryato, 2016). When there are more free radicals than antioxidants in the body, this is a condition known as oxidative stress (Husna, 2019).

As compared to the blood glucose levels of N mice, the first week of observation showed that the blood glucose levels of KP, KN, P1, P2, and P3 were all considered to be mild hyperglycemia. P2 and KP mice were identified as having mild hyperglycemia in the second week. Moderate hyperglycemia is the blood glucose level found in P1, P3, and KN rats. The blood sugar KP, P1, and P2 are characterized as having mild hyperglycemia as of the third week. Moderate hyperglycemia is the glucose level found in P3 and KN rats.

Moreover, P2, KP, P1, and P3 rats had blood glucose levels that were categorized as low hyperglycemia, according to the findings of monitoring blood glucose levels on the fourth Sunday. The KN rats had persistently elevated glucose levels, which are categorized as severe hyperglycemia. The blood sugar levels of the P2 and KP rats under this treatment were comparable to those of normal rats. This suggests that providing the rats 2 ml/kg BW of senggani fruit vinegar over the course of 28 days caused their blood glucose levels to drop to a normal range.

As Senggani fruit vinegar had been fermented for 28 days and had been tested to have high antioxidant activity, the fall in blood glucose in the rats receiving the KP, P2 treatment had returned to normal blood glucose levels in the fourth week (28 days) of observation (Safrida, 2022). According to Zubaidah (2015), acetic acid, which is present in vinegar, slows down the disaccharidase enzymes involved in metabolism, assisting the body in managing high blood sugar levels. Fruit vinegar contains flavonoid elements, antioxidants, and acetic acid, which work together to prevent oxidative stress situations, repair pancreatic beta cells, and permit the hormone insulin to be released appropriately, resulting in drops in blood glucose levels. cannot happen (Hamidatun, 2014).

According to other studies, apple cider vinegar is produced utilizing a fermentation process to extract flavonoids, which serve as antioxidants, from actual apples. When mice with hyperglycemia are given apple cider vinegar, their blood glucose levels drop because the vinegar's flavonoid chemicals function as antioxidants to rejuvenate pancreatic beta cells, which emit the hormone insulin as the body requires (Zubaidah, 2015).

Rats feeding effectiveness was also evaluated in this study. The findings of the 28-day data analysis revealed that there were variations in the average for each therapy.

Table 1. 28-day data analysis

	Feed Efficiency (grams)			
Treatment	Week 1	Week 2	Week 3	Week 4
N	34.6	36.4	34.6	45.6
KP	36	29.5	26.1	23.4
KN	34.3	31.6	29.9	24.2
P1	35.7	27.2	19.9	19.3
P2	39.8	28.6	28.6	13
P3	34.3	20.9	12.9	7.9

Many elements have an impact on growth. These elements include dietary expertise and consumption habits (Kristanti, 2021). Male rats grow more quickly and, depending on their age and strain, can weigh as much as 200–250 g when they reach sexual maturity (Aminah, 2015). Males gain more body weight than females even when they consume roughly the same amount of feed (Sianturi, 2016). Urine glucose levels rise in rats and peak at their highest levels. High blood glucose levels cause the kidneys to be unable to store it, thus it is expelled in the urine as a result (Wulan, 2012).

The rat consumes more feed when its blood glucose level is higher. Conversely, if blood glucose levels drop, rat feed consumption will as well (Putra, 2020). According to Rizah's (2015) research, administering winged bean protein extract to alloxan-induced diabetic rats can drop blood glucose levels by as much as 49% and cause a decrease in rat feed consumption compared to the group of rats that only receive conventional feed. In their study, Okon et al. (2012) made a similar claim, reporting that diabetic rats induced by streptozotocin who received a liquid extract of Ocimum gratissimum leaf showed reduced blood glucose levels and feed consumption compared to diabetic rats who did not receive any treatment. Many studies have shown that the Senggani fruit vinegar research has an impact on lowering glucose, which will change how much food rats consume. According to the findings of the data gathered, rats fed Senggani fruit vinegar can lower their blood glucose levels, and the consumption of rat feed provided Senggani fruit vinegar also decreases.

Conclusion

According to the findings of this study, senggani fruit vinegar (*Melastoma affine D. Don*) reduced blood glucose levels and decreased food intake in hyperglycemic white rats.

Acknowledgements
Thank you to RISPRO for funding scientific research with a contract no 011/E4.1/AK.04.RA/2021 date December 1,2021 and Dirut LPDP number KEP-2/LPDP/LPDP.4/2021.

Author Contributions
Conceptualization, S.S. and A.M.D.; methodology, M.M.; validation, K.K.; formal analysis, S.S.; investigation, S.S.; data curation, A.M.D.; writing—original draft preparation, S.S and R.A; writing—review and editing, S.S dan R.A.

Funding
This research received to RISPRO for funding scientific research.

Conflicts of Interest
No Conflicts of interest.

References

Agustono, A., & Cahyoko, Y. (2019). Feeding with Different Energy on Growth of Grouper (Cromileptes altivelis) Seeds [Feeding with Different Energy To Growth Of Groupers (Cromileptes altivelis)]. *Marine and Fisheries Scientific Journal*, 1(2), 149-156. https://doi.org/10.20473/jipk.v1i2.11681

Ajie, R. B. (2015). White Dragon Fruit (Hylocereus undatus) Potential as Hyperglycemia Mellitus Treatment. *Majority*, 4(1), 69-72.

Al-Ishaq, R. K., Abotaleb, M., Kubatka, P., Kajo, K., & Büsselberg, D. (2019). Flavonoids And Their Anti-Diabetic Effects: Cellular Mechanisms And Effects To Improve Blood Sugar Levels. *Biomolecules*, 9(9), 1-35. https://doi.org/10.3390/biom9090430

Aminah, S., & Yusuf, M. (2015). Efisiensi Pakan, Berat Badan dan Panjang Tulang Tikus yang Mengkonsumsi Kejale selama 6 Minggu. In *Prosiding Seminar Nasional & Internasional*. Retrieved from https://jurnal.unimus.ac.id/index.php/psn12012010/article/view/1624

Darliana, D. (2011). Management of Nursing Care in Patients with Hyperglycemia Mellitus. *Idea Nursing Journal*, 2(2), 132-136. https://doi.org/10.52199/inj.v2i2.6371

Dewi, A. C., Widyastuti, N., & Probosari, E. (2020). The Effect of Sorghum (Sorghum bicolor L. Moench) Flour on Fasting Blood Glucose Levels in Diabetic Rats. *Journal of Nutrition College*, 9(1), 63-70. https://doi.org/10.14710/jnc.v9i1.24266

Hamidatun, H., Mandasari, O. K., Rosdiana, I., & Widiyana, S. D. (2014). Pengaruh cuka salak terhadap penurunan glukosa darah dan histopatologi pankreas tikus diabetes. *Program Kreativitas Mahasiswa-Penelitian,* 1-6. Retrieved from https://media.neliti.com/media/publications/172273-ID-pengaruh-cuka-salak-terhadap-penurunan-g.pdf

Hardianto, D. (2020). Comprehensive Review of Hyperglycemia Mellitus: Classification, Symptoms, Diagnosis, Prevention, and Treatment:

Indonesian Biotechnology & Bioscience (Jbbi), 7(2), 304-317. https://doi.org/10.29122 /jbbi. v7i2.4209

Hardoko, M., Sasmito, B. B., & Fitriani, E. N. (2020). Study of the Antidiabetic Activity of Mangrove Bedada (Sonneratia alba) Vinegar in Vivo. *Jfmr (Journal of Fisheries and Marine Research)*, 4(3), 399-407. https://doi.org/10.21776/ub.jfmr.2020.004.03.13

Haryoto, H., Nurhardianti, N., Sujono, T. A., Suhendi, A., & Muhtadi, M. (2016). Antidiabetes Mellitus Ekstrak Etanol Kulit Batang Tumbuhan Sala (Cynometra Ramiflora L.) Terhadap Tikus Jantan Galur Wistar yang Diinduksi Aloksan. *Prosiding Universty Research Colloquium, 2*(1), 113-122. Retrieved from https://publikasiilmiah.ums.ac.id/xmlui/handle/11617/6721

Husna, F., Suyatna, F. D., Arozal, W., & Purwaningsih, E. H. (2019). Experimental Animal Models in Hyperglycemia Research. *Pharmaceutical Sciences and Research*, 6(3), 131–141. https://doi.org/10.7454/psr.v6i3.4531

Irdalisa, I., Safrida, S., Khairil, K., Abdullah, A., & Sabri, M. (2015). Profil kadar glukosa darah pada tikus setelah penyuntikan aloksan sebagai hewan model hiperglikemik. *Jurnal EduBio Tropika, 3*(1), 25-28. Retrieved from https://jurnal.usk.ac.id/JET/article/view/5272

Kamalakannan, N., & Prince Psm, (2016). Antihyperglycaemic and Antioxidant Effect of Rutin, A Polyphenolic Flavonoid, in Streptozotocin Induced Diabetic Wistar Rats. *Basic & Clinical Pharmacol & Toxicol*, *98*(1), 97-103. https://doi.org/10.1111/j.17427843.2006.pto_241.x

Kristanti, D., Pratiwi, V. N. R., Rahayu, E. S., & Astuti, M. (2021). Diet of Brown Rice and Parboiled White Rice in Hyperglycemic Rats. *Nutrition and Food Research (The Journal of Nutrition and Food Research), 44*(2), 93-104. https://doi.org/10.22435/pgm.v44i2.4421

Okon, U. A, Owo, D. U., Udokang, N. E, Udobang, J. A & Ekpenyong, C. E. (2012). Oral administration of aqueous leaf extract of Ocimum Gratissimum Ameliorates Polyphagia, Polydipsia and Weight Loss in Streptozotocin-Induced Diabetic Rats. *American Journal of Medicine and Medical Sciences,* 2(3), 45-49. https://doi.org/10.5923/j.ajmms.20120203.04

Ousaaid, D., Mechchate, H., Laaroussi, H., Hano, C., Bakour, M., El Ghouizi, A. & El Arabi, I. (2021). Fruits Vinegar: Quality Characteristics, Phytochemistry, And Functionality. *Molecules*, *27*(1), 222-225. https://doi.org/10.3390/molecules27010222

Putra, M. A. D., Jannah, S. N., & Sitaswi, A. J. (2020). Antidiabetic Activity Test of Pineapple Peel Vinegar (Ananas comosus L. Merr.) on Alloxan-Induced Wistar Male White Rats (Rattus norvegicus). *Pro-Life Journal,* 7(2), 188-197. https://doi.org/10.33541/jpvol6Iss2pp102

Rizah, R. W. (2015). Hypoglycemic effect of winged bean protein extract (Psopharpus tetragonolobus) on Alloxan Induced Diabetic Rats. *Scientific Journal of Technoscience*, *1*(1), 1-6. https://doi.org/10.26877/jitek.v1i1November.831

Roslen, N.A., Alewi, N.A.M., Ahamada, H. And Rasad, M.S.B.A. (2014). Cytotoxicity Screening of Melastoma malabathricum Extracts on Human Breast Cancer Cell Lines In Vitro. *Asian Pac J Trop Biomed* 4(7), 545-548 https://doi.org/10.12980/APJTB.4.2014C658

Safrida, S., Ulhusna, F. A., Gholib, G., Matualiah, M., Adinda, R., Putri, Y. A., & Fitria, N. (2023). Phytochemical Characterization and Sensory Evaluation of Vinegar from Melastoma malabathricum L. Flowers with Variations in Starter Concentration and Fermentation Time. *Jurnal Penelitian Pendidikan IPA, 9*(2), 706-713. https://doi.org/10.29303/jppipa.v9i2.2940

Sianturi, E. M., Fuah, A. M., & Wiryawan, K. G. (2016). Study of the addition of tape yeast to feed on consumption, body weight gain, feed conversion ratio, and mortality of rats (Rattus norvegicus). *Livestock Media*, *29*(3). https://doi.org/10.5398/medpet.v29i3.825

Singh, L. K., Karlo, T., & Pandey, A. (2014). Performance of Fruit Extract of Melastoma malabathricum L. *Journal Molecular and Biomolecular Spectroscopy,* 1(1), 938-943. https://doi.org/10.1016/j.saa.2013.09.075

Wulan, S. N., Astuti, M., Marsono, Y., & Noor, Z. (2012). Testing the Hypoglycemic Effects of Soybeans, Soybean Protein Fractions and Tempeh in Diabetic Rats. *Jurnal Teknologi Pertanian*, 3(2), 94-102. Retrieved from https://jtp.ub.ac.id/index.php/jtp/article/view/142

Zatalia, S. R., & Sanusi, H. (2013). The Role of Antioxidants in The Pathophysiology, Complications, And Management of Hyperglycemia Mellitus. *Acta Medica Indonesiana*, 45(2), 141-147. Retrieved from https://europepmc.org/article/med/23770795

Zubaidah, E. (2015). Effects of Apple Vinegar and Salak Vinegar on Decreased Blood Glucose and Pancreatic Histopathology of Wistar Rats with Hyperglycemia. *Brawijaya Medicine*, 28(4), 297-30. https://doi.org/10.21776/ub.jkb.2015.028.04.7