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Effectiveness of "Camerunis" cookies made from functional ingredients as a healthy snack to prevent degenerative diseases

Efektivitas cookies "Camerunis" berbahan fungsional sebagai selingan sehat pencegah penyakit degenerative

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Abstract

The consumption of monster cookies and dessert boxes can be detrimental to health. This study produces cookies from a mixture of functional ingredients such as wheat flour, mocaf, brown rice, and cinnamon, which are named Camerunis Cookies as an alternative to healthier cookies that prevent degenerative diseases such as Diabetes Mellitus. This study aimed to determine the nutritional value, glycemic index, and antioxidant activity of Camerunis cookies as well as their effect on their impact in the prevention of degenerative diseases (DM) in experimental animals. Blood glucose levels in experimental animals. The research method used was a quasi-experimental design. The number of samples was 15 white male rats divided into 3 groups, namely normal rats, diabetic rats without giving and diabetic rats by giving Camerunis Cookies. Camerunis Cookies were produced in the Food Laboratory of Poltekkes Kemenkes Yogyakarta. Proximate, glycemic, antioxidant, and blood glucose levels were tested in experimental animals at the laboratory of Pusat Antar Universitas (PAU) UGM Yogyakarta. The research data were descriptively analyzed. The moisture content of the C. cookies was 2,18%, ash content of 1,95%, and 6,40%, respectively. fat 31,74%. carbohydrates (57,72%), the glycemic index (35 IG), and antioxidants (27,6 µg/mL. The average reduction in blood glucose levels in the DM rats was 41,55 mg/dL per week. In conclusion, Camerunis cookies meet the SNI 01-2973-1992 standards, have a low glycemic index, contain strong antioxidants, and can reduce blood glucose levels in DM rats.

Keywords: Antioxidants, Cookies camerunis, cinnamon, diabetes mellitus, glycemic index

Abstrak

Trend konsumsi *cookies* monster dan *dessert box* dapat merugikan kesehatan. Penelitian ini memproduksi *cookies* dari bahan fungsional seperti tepung terigu, mocaf, beras merah, dan kayu manis, yang diberi nama *Cookies Camerunis sebagai alternative Cookies yang lebih sehat pencegah penyakit degeneratif seperti Diabetes Mellitus*. Penelitian bertujuan untuk mengetahui nilai gizi *Cookies Camerunis*, serta dampaknya dalam pencegahan penyakit degenerative (DM) pada hewan coba. Metode penelitian berdesain *quasi experimental.* Jumlah sampel 15 ekor tikus jantan putih yang dibagi dalam 3 kelompok yaitu tikus normal, tikus diabetes tanpa pemberian dan tikus diabetes dengan pemberian *Cookies Camerunis*. Produksi *Cookies Camerunis* di Laboratorium Pangan Poltekkes Kemenkes Yogyakarta. Uji proximat, uji glikemik, uji antioksidan, dan uji kadar glukosa darah hewan coba di laboratorium Pusat Antar Universitas (PAU) UGM Yogyakarta. Data dianalisis secara deskriptif. Hasil, *Cookies Camerunis* mempunyai kadar air 2,18%, kadar abu 1,95%, kandungan protein 6,40%. lemak 31,74%. karbohidrat 57,72%, indeks glikemik sebesar 35 IG dan antioksidan sebesar 27,6 µg/mL Rerata penurunan kadar glukosa darah pada tikus DM sebesar 41,55 mg/dL per minggu. Kesimpulan, *Cookies Camerunis* memenuhi standar SNI 01-2973-1992, mempunyai indeks glikemik rendah, mengandung antioksidan yang

sangat kuat, dan bisa menurunkan kadar glukosa darah tikus DM.

Kata Kunci: Diabetes mellitus, Cookies Camerunis, kayu manis, antioxidants, indeks glikemik

Introduction

Since 2016, non-communicable diseases (NCDs) have caused 72% of global deaths, the cause of which is a combination of various factors, including genetic, physiological, environmental, and behavioral factors (BKPK, 2024). The results of the 2023 Indonesian health survey by the Health Development Policy Agency (in Indonesian called BKPK) show that trends in Diabetes Mellitus (DM) in the population aged ≥15 years based on doctors' diagnoses are increasing (from 2,0% to 2,2%), as well as for DM. in residents of all ages (from 1,5% to 1,7%) compared to the RISKESDAS 2018 (Basic Health Research) results (BKPK, 2024).

Diabetes mellitus is a non-communicable disease resulting from chronic metabolic disorders caused by the pancreas not producing enough insulin or the inability of the body to effectively utilize the insulin produced. Insulin is a hormone that regulates the concentration of sugar in the blood and remains balanced. There are several types of DM, including type 2. Factors that cause type 2 DM include unbalanced food intake, namely, high sugar and low fiber, which causes an increase in postprandial blood sugar concentration (Fatimah, 2015; Rahmad, 2021). The prevention of type 2 DM by regulating blood sugar levels can be achieved by adjusting eating habits (Gates et al., 2022; Wardani et al., 2024). Eating habits in DM sufferers can be regulated, among other things, by replacing food consumption with foods that are high in fiber, high in antioxidants, and have a low glycemic index.

Patients with diabetes are not recommended to consume foods with a high glycemic index because they will trigger a significant increase in blood sugar levels. Current food trends such as monster cookies and dessert boxes are popular among the public, including children, teenagers, adults, and the elderly (Krisda, 2023). Peningkatan permintaan pasar menyebabkan The two foods mentioned above are easy to find and consume by people without thinking about their long-term health effects. People who consume processed foods that tend to be sweet and exceed food regulations are at a risk of DM (Bhatti et al., 2020). Camerunis cookies are an alternative healthy distraction that does not pose a risk for DM.

Camerunis cookies are healthy snacks produced from a variety of mixtures of wheat flour, processed cassava flour (mocaf), brown rice flour, and cinnamon flour. Mocaf flour is processed from cassava flour using lactic acid bacteria (LAB) via a fermentation method. (Nurhanifah et al., 2020). Cinnamon plants have been studied and are known to exhibit antidiabetic activity (Emilda, 2018). Cinnamon is a food ingredient that has been proven to lower blood sugar levels. Various studies have shown the effect of cinnamon in reducing blood sugar levels. Zarezadeh (2023) showed that cinnamon can be used as an antidiabetic agent and as an additional treatment to control the glycemic index in patients. From the findings of various studies, it can be concluded that oral administration of cinnamon extract has a nutraceutical effect on blood glucose levels through various metabolic pathways. Cinnamon is used as a natural traditional medicine in various cultures worldwide (Mohsin et al., 2023). Thus, cinnamon can be more attractive and light to consume and can be modified into a snack in the form of cookies.

However, the effectiveness of Camerunis Cookies in reducing blood sugar levels to prevent DM is unknown. Thus, it is necessary to conduct research on the nutritional content of Camerunis cookies, which can have an impact on preventing DM. Therefore, the aim of this study was to determine the nutritional value, glycemic index value, and antioxidant value of Camerunis Cookies, and its effect on diabetes in experimental animals

Methods

The research was quasi-experimental. The study was conducted from June 3 to October 17, 2024. Analysis of nutrients (proximate

test), antioxidants (DPPH test), and their effect on experimental animals with diabetes (STZ induction) was carried out at the UGM Yogyakarta Inter-University Central Laboratory (PAU). Measurement of water, ash, protein, and fat concentrations by proximate tests. Proximate testing is a series of chemical analyses performed to determine the main nutritional content of food ingredients, such as Camerunis Cookies. Measurement of antioxidant activity by DPPH free scavenging activity. The DPPH test measures the antioxidant properties of a substance using the free radical 2,2-diphenyl-1-picrylhydrazyl (DPPH). The principle of the test was to react the antioxidant compounds with DPPH free radicals. The antioxidant compounds in Camerunis cookies donate their hydrogen atoms to the DPPH radical, which changes to the reduced non-radical form and loses its purple color.

The streptozotocin (STZ) induction test was used to test the effect on experimental animals for diabetes using white male mice that had been induced by STZ. STZ is cytotoxic because it is composed of glucosamine and nitrosourea. STZ induction causes insulin production and release to stop, resulting in DM in mice. For the STZ induction test, according to WHO criteria (1993), a minimum of five test animals were required in each treatment group. Fifteen white male rats were divided into three groups; each group consisted of five rats, namely normal rats, diabetic rats without Camerunis Cookies, and diabetic rats administered Camerunis Cookies. All mice were allowed to adapt for 7 (seven) days. Mice were placed in individual cages and closed cages with sufficient light at room temperature.

During the study, all mice were given standard food and cared for according to the code of ethics for experimental animals at the PAU UGM Laboratory. The body weights of all the mice were measured on days 1 and 8. On day 8, two groups of mice were treated with 45 mg/kg STZ, 2 ml/200 gr citrate buffer, 110 ml/kg sodium, and 2 ml/kg saline. STZ induction results in toxicity in pancreatic cells, causing high blood sugar levels in mice. This condition occurred three days after STZ induction. On the 12th day, the body weight and blood sugar levels of all mice were measured. Starting on day 12, one group of DM mice was given Camerunis Cookies at 0,9 gr/200 gr BW. On the 12th day, there were three groups of experimental mice: a group of mice without STZ induction, a group of STZ-induced mice that were not given Camerunis Cookies, and a group of STZ-induced mice that were given Camerunis Cookies. This treatment lasted for four weeks. Every week, the body weight and blood glucose levels of all mice were measured.

The data were processed and analyzed descriptively to describe the decrease in blood sugar levels in experimental animals by calculating the average blood glucose levels of mice for each group per week. Changes in blood sugar levels were analyzed during the study and presented in a graphical form to determine the trend of changes in blood glucose levels.

Ethical permission was obtained from the Yogyakarta Ministry of Health Polytechnic Health Research Ethics Committee (number: DP.04.03/e-KEPK.1/765/2023).

Result and Discussion

Proximate Test

Proximate analysis is a chemical method used to measure the nutritional content of food products, including carbohydrates, proteins, fat, water, and ash. The proximity test of the Camerunis Cookies was carried out at the PAU UGM Yogyakarta Laboratory. The results of the proximate tests are presented in Table 1.

Table 1. Cookies Camerunis proximate test results

Mark Proximate	Cookies 1	Cookies 2	Average
Water (%)	2,19	2,17	2,18
Ash (%)	1,92	1,99	1,95
Fat (%)	32,07	31,41	31,74
Protein (%)	6,78	6,03	6,4
Carbohydrates (%)	57,04	58,4	57,72

As shown in Table 1, the water, ash, and protein contents were 2,18 %, 1,95%, and 6,40%, respectively. fat of 31,74%. and a carbohydrate content of 57,72%. Based on SNI 01-2973-1992 regarding biscuit products, Camerunis cookies meet SNI standards

(Mastan, 2023). Camerunis cookies contain more protein than cookies made from kepok banana and green bean flour (Afifah et al., 2020) and lower than cookies made from tempeh flour (Madani et al., 2023).

Figure 1. Cameroonian Cookies

Antioxidant Test

The antioxidant activity test of the Camerunis cookies was carried out at the PAU UGM Yogyakarta Laboratory. The antioxidant activity of 100 g of Camerunis cookies was 27,6%. These results indicate that C. cookies have high antioxidant activity. Based on IC50 (inhibition concentration), an antioxidant is said to be very strong if its IC50 value is less than 50, strong if (50-100), moderate if (100-150), and weak if (151-200) (Dewi et al., 2016).

Glycemic Index

Food types with a low glycemic index (GI) can be found in foods with fiber and high resistant starch levels. The IG value of Camerunis Cookies in this study was 35. Based on the food classification according to GI, it was grouped into three categories: low if < 55, medium if 55 – 70, and high if > 70, so that the GI of Camerunis Cookies was included in the low GI group.

The Effect of Camerunis Cookies on Experimental Animals

The effects of Camerunis cookies on experimental animals were examined in white male mice at the PAU UGM Yogyakarta Laboratory. The following is a graph of the results of the blood glucose tests on experimental mice, which can be seen in Figure 2.

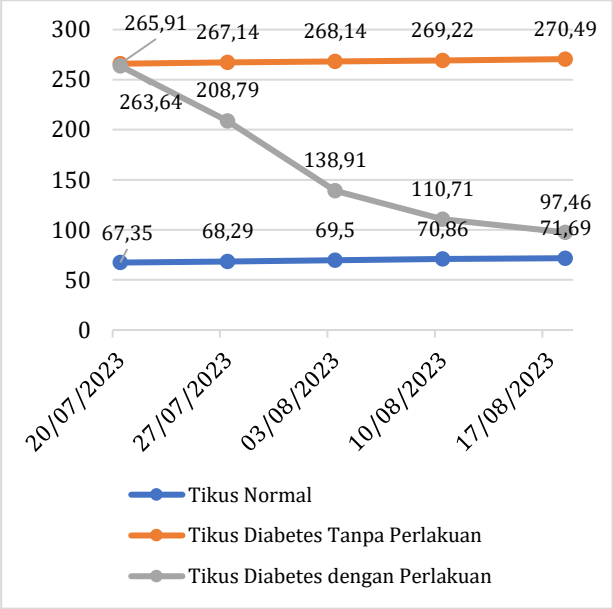

Figure 2. Comparison of blood glucose levels in test mice

In the blue line graph, it can be seen that healthy mice that were not given Camerunis Cookies had relatively normal blood glucose levels. In the orange line graph, diabetes mellitus mice that were not administered Camerunis cookies showed high blood glucose concentrations. This shows that the mice were still in a hyperglycemic state. In the gray line graph, diabetes mellitus mice that were given Camerunis Cookies showed a decrease in blood glucose levels every week. The average decrease in blood sugar concentration in the mice was 41,55 mg/dL.

The blood sugar concentration of diabetic mice administered Camerunis cookies for one month decreased. Meanwhile, untreated mice with diabetes mellitus had high blood glucose levels. This suggests that Camerunis Cookies can reduce blood glucose levels in mice with diabetes mellitus. The results of this study are in line with research on giving cinnamon powder (Kondoy et al., 2013; Kusumaningtyas et al., 2014), cinnamon extract (Ramadhan et al., 2023), cinnamon combination tea (Buang, 2019) and cinnamon infusion (Kusumaningtyas et al., 2014), which states that giving cinnamon to experimental animal feed will reduce blood glucose levels. Likewise, research results from Laura et al. (2019) showed that personalized nutrition can prevent and treat chronic degenerative diseases (Di et al., 2019).

Therefore, consuming Camerunis Cookies as an alternative daily snack can help prevent degenerative diseases because the nutrient, antioxidant, and low GI contents can reduce blood glucose concentrations.

One of the ingredients in Camerunis Cookies that supports the lowering of blood glucose is antioxidant content. This research is in line with research by Widaryanti et al. (2016), who found that blood glucose in DM experimental animals could be reduced by 44% with a decoction of lemongrass high in antioxidants (p=0,0001)(Widaryanti, 2016). Other studies have also shown that the use of antioxidants in patients with diabetes mellitus is effective in reducing the emergence of complications (Prawitasari, 2019; Soviana et al., 2014).

Adjusting the diet using plant-based foods such as Camerunis Cookies can be an alternative choice for preventing DM. It is important for people with type 2 DM to control food portions, especially portion sizes, to prevent overeating. Frequent consumption of small portions of food can help control daily blood sugar levels. The recommended eating pattern is, for example, consuming large meals three times a day (07.00, 12.00, 18.00), consuming snacks twice a day (10.00, 14.00), and avoiding consuming a lot of food. at one time because this can trigger a spike in blood sugar levels (Purtiantini, 2024). Healthy snacks made from plant materials such as Camerunis Cookies will be helpful in controlling spikes in blood sugar levels. Several studies have proven that adjusting the diet using plant-based foods is effective in the treatment of patients with type 2 DM (Jardine et al., 2024; Mcmacken & Shah, 2017). Plant-based diets can help prevent and improve metabolic syndrome and neurodegenerative diseases by reducing oxidative stress and inflammation (Francesca Pistollato a, 2014). Antidiabetic plant-derived molecules and foods show potential in managing diabetes mellitus with fewer side effects and less dependence on synthetic drugs (Naveen, J., & Baskaran, 2018; Zhu et al., 2011).

Conclusion

Camerunis cookies have been proven to be effective in lowering blood sugar levels in experimental animals; therefore, they can be an alternative healthy distraction made from functional plant-based ingredients in managing the diet of patients with type 2 diabetes mellitus (DM) to prevent spikes in blood sugar levels. Camerunis Cookies also meet the SNI 01-2973-1992 standards, with low glycemic index criteria, and contain cinnamon and very strong antioxidants to lower blood sugar levels, which is very suitable for the needs of Type 2 DM sufferers. Camerunis Cookies can be used as an alternative food for healthy districts to prevent DM

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