

Hypoglycemic Effect Of Pigeon Pea (*Cajanus Cajan*) IN Diabetes Mellitus

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ABSTRACT

Background: Pigeon pea is a local food containing active substances and antioxidants that can potentially manage diabetes mellitus (DM). This disease has become a public health problem worldwide. As a result, various management efforts have been made, including utilizing potential foods in meal planning for people with diabetes.

Objective: To determine the hypoglycemia effect of consuming pigeon pea (*Cajanus cajan*) in diabetes mellitus.

Research Methods: This type of research is a literature review. Literature search used ProQuest, science direct, Pubmed, Garuda Garba, and Google Scholar databases. Strategies for finding articles using the PICOS framework, reviewing the quality of reports using the PRISMA checklist, and critical appraisal according to the experimental research design.

Research Result: The eleventh study reviewed found a significant effect ($p < 0.05$) on reducing blood sugar levels in animal and diabetes mellitus patients.

Conclusion: The content of isoflavones and high antioxidant activity in pigeon pea (*Cajanus cajan*) can reduce blood glucose levels in mice, rats, and people with diabetes mellitus.

BACKGROUND

Diabetes Mellitus (DM) is a non-communicable disease that is a severe public health problem worldwide because sufferers always experience an increase yearly. The International Diabetes Federation (2019) reported that 463 million people with diabetes worldwide. Indonesia is ranked seventh with 10.7 million cases and is predicted to increase to 13.7 in 2030 and 16.6 million in 2045 (Atlas, 2019). Basic Health Research in 2018 reported the prevalence of DM based on a doctor's diagnosis of 2.0%, an increase from 1.5% in 2013. DKI Jakarta occupied the highest prevalence with 3.4%, and the lowest was in Maluku and Papua with 1.1 %. The prevalence of DM in Mataram City is also relatively high compared to other areas in NTB at 1.7% (Ministry of Health RI, 2018).

Characterized DM is chronic hyperglycemia which can cause organ function disorders or complications such as macroangiopathy and microangiopathy (Yusarini & Duniaji, 2019). Advanced complications in people with diabetes mellitus can be avoided correctly by carrying out nutritional therapy. Nutritional interventions carried out for DM therapy include carbohydrate counting, reducing energy intake, and choosing functional foods that positively impact DM sufferers (Franz & Alison, 2012) (Danuyanti et al., 2019). The selection of functional foods can be obtained from readily available or local foods, for example, such as pigeon peas.

Pigeon peas (*Cajanus cajan*) in Indonesia are known by various regional names such as album (Lombok, NTB), undies (Bali), pigeon peas (Java), Lauang (Makassar), faucet (Ternate and Tidore) and wood nuts (Kisar- Southwest Moluccas). Dried pigeon peas contain 316 kcal of energy, 20.7 grams of protein, 1.0 grams of fat, 58 grams of carbohydrates, and 4.6 grams of fiber. Micronutrients are also high,

namely 4.7 grams of iron, 146 grams of calcium, and 1306 mg of potassium per 100 grams (Kemenkes RI, 2019).

Pigeon pea contains anthocyanin pigment, an antioxidant that can lower blood cholesterol levels. The ability of anthocyanins is more active than vitamin E in destroying free radicals (Al-Lawi, 2011). Various free radicals, such as superoxide radicals and hydrogen peroxide, are believed to be destroyed by anthocyanins. In pigeon pea seeds, there are 3.82% phenols, 2.65% alkaloids, and 2.11% flavonoids (Sahu & Haris, 2014). Research (Danuyanti et al., 2019) reported that pigeon pea tempeh had a high % antioxidant activity of 15%, with a total antioxidant of 41.3%. Furthermore, his research reported that giving tempeh powder could reduce blood glucose levels and improve lipid profiles in rats with diabetes mellitus models. The pigeon pea tempeh cooked in stir fry has a higher antioxidant activity of 17.5%, with a total antioxidant of 42.5% (Sulasty et al., 2019). (Yusasrini & Duniaji, 2019)his research reported that giving pigeon pea tempeh could reduce rat blood glucose levels from 323.5 mg/dl to 200.4 mg/dl. Based on the description above, the authors conducted a literature review regarding the effectiveness of pigeon peas in reducing blood glucose levels.

MATERIAL AND METHODS

The type this research is a literature review on experimental animals and diabetes mellitus patients. The literature search used Google Scholar, Garuda Garba, ProQuest, and Pubmed. The keywords used were *Cajanus cajan*, hypoglycemic effect, blood glucose level, pigeon peas, pigeon peas, blood glucose levels, and diabetes mellitus. They assess the quality of each study using a checklist according to the research design used. A score of one is given for "yes" answers per question and a score of zero for 'no,' 'unclear' or 'not applicable' answers. Then the answer scores are summed up. If the total score reaches 50% or more, the article can be reviewed in the analysis. The mean score for the quality of the articles used in this study was 95.5%.

RESULTS

The search found eleven articles about the effect of pigeon peas on blood glucose levels in experimental animals and diabetic patients. Details are presented in Table 1.

Table 1. The Effect of Pigeon Peas on Blood Glucose Levels

No.	Reference	group	Blood Glucose Levels		p value
			pre	post	
1	(Ahmed, Kamrujjaman, Rahmatullah, Hossain, & Fariba, 2017)	controls 1	6.12±0.16	0	<0.05
		control 2	3.44±0.22	43.8	
		P1 (50)	4.96±0.28	19.0	
		P2 (100)	4.20±0.35	31.4	
		P3 (200)	4.08±0.21	33.3	
2	(Ariviani, Affandi, Listyaningsih, & Handajani, 2018)	P4 (400)	3.60±0.13	41.2	<0.05
		control	73.54±0.89	73.93±1.45	
		P1	226.62±2.26	231.97±3.97	
3	(Uchegbu & Ishiwu, 2016)	P2	227.71±2.80	150.60±1.50	<0.05
		pigeon pea sprouts	2.01±0.25	1.43±0.33	
4	Nneka N Uncegbu (2016)	Control 1 (fed normal feed) Control 2-6 (feed biscuits)	±220 mg/dl	±100 mg/dl	<0.05
5	Danuyanti, et al (2019)	Normal P1 (diabetes) P2 (25%) P3 (50%) P4 (75%)	P4 formula reduced glucose levels by 44.08%		<0.05

6	(Suhaema & Cahyaningrum, 2017)	pigeon pea tempeh+ginger	203.7±83.6 mg/dL	186.6±70.0 mg/dL	0.015	
7	Yusasrini and Jambe (2019)	Confession PS- Negative PS-Positive PKG(Powder Bean Food)	323.68 mg/dl	200.37 mg/dl.	<0.05	
8	(Suhaema & Abdi, 2018)		227.3±60.2	167.7±30.1	227.3±60.2	0.001
10.	(Manzo & Vitor, 2017)	control – control + Low dose Medium dose High dose	160.44±17.84 183.00±30.72 150.44±16.50 147.56±28.12 137.33±15.99	130.00±11.90 67.33±13.02 134.44±15.74 83.78±9.86 98.56±7.80	p<0.05	
11.	(Shakappa, Talari, Rakesh, & Pradhan, 2022)	Groups control Raffinose Pigeon peas	30 min 160 a ±21.0 158 a ±14.7 120 b ±22.5	120 min 121 a ±9.5 129 a ±7.3 90 b ±9.3	p<0.05	

Several studies have investigated the content of active substances and antioxidant activity in pigeon peas, as presented in Table 2 below.

Tabel 2. Nutritional Content And Bioactive Substances of Pigeon Pea (*Cajanus cajan*)

No.	Author	Product	Results
1	(Akyun, 2017)	Pigeon pea yogurt	content of daidzin compounds 0.54-0.8 µg/g and daidzein 1.78-7.83 µg/g
2	(Rahayu & Fidyasari, 2022)	pigeon pea flour	The best treatment was A2 treatment (soaking 24 hours and boiling 10 minutes) containing 6.16% water content, 0.94% ash content, 24.32% protein, 2.94% fat, 65.64% carbohydrates and 3.21% fiber.
3	(Sulasty et al., 2019)	Stir-Fried Fermented of pigeon pea (tempeh)	total antioxidant 42.53%, antioxidant activity 17.48%, dietary fiber total 23.26% db, protein 7.48%, carbohydrate 24.34%, and lipid 1.39%.
4	(Yusasrini & Duniaji, 2019)	Pigeon pea tempeh	Protein 21.54 %, fat 2.89%, crude fiber 6.35%, antioxidant activity 379.06 mg/L

DISCUSSION

Pigeon pea is one of the potential legumes in the health sector because it contains antioxidants and nutrients that are pretty good as antihyperglycemic compounds. Research conducted by (Roosmarinto & Rahayu, 2016) showed that testing for antioxidant activity using the DDPH method resulted in an IC50 value of 70.32 mg/ml. In addition, pigeon pea contains anthocyanin compounds of 208.307 mg/100 grams. In this study, it was shown to inhibit the increase in the activity of the enzymes AST, ALT, and GGT as well as MDA because if MDA levels increase, it will result in a state of oxidative stress related to diabetes mellitus.

The research that was conducted (by Ahmed et al., 2017) showed that giving methanol extract from pigeon pea seeds that were not boiled could reduce blood glucose levels by 19.0%, 31.4%, 33.3%, and 41, 2%, respectively, at doses of 50, 100, 200 and 400 mg/kg BW in rats. Meanwhile, administration of methanol extract from boiled pigeon pea seeds reduced blood glucose levels by 12.7, 21.6, 34.3, and 34.8% at doses of 50, 100, 200, and 400 mg/kg BW, respectively, in rats. Thus, boiled and unboiled pigeon pea seed extract can lower blood glucose levels even though it has a lower effect after boiling.

The study conducted by (Ariviani et al., 2020) showed that there was a decrease in blood glucose levels in rats induced by alloxan after being given pigeon pea drink for one week, from 227.71 mg/dl to

188.71 mg/dl and fell back to 150.60 mg/dl after being given for two weeks. This proves that the pigeon pea drink can exhibit a hypoglycemic effect, potentially being used as a functional drink for people with diabetes mellitus.

Research (Uchegbu & Ishiwu, 2016) showed decreased blood sugar levels in diabetic rats after being fed pigeon pea sprout powder. This study was divided into three treatment groups. Group 1 as a control, namely non-diabetic rats, was given a regular diet; group 2 were diabetic rats given a high-fat diet, and group 3 was given a pigeon pea sprout diet (for four weeks). The final results showed an increase in fasting blood glucose levels of rats given a high-fat diet, from 220 mg/dl to 400 mg/dl, until the fourth week, while rats given a diet of germinated pigeon peas experienced a decrease in blood glucose levels from 220 mg/dl to 150 mg/dl until the fourth week. Thus, the intake of pigeon peas can potentially control hyperglycemia.

Furthermore, research conducted by (Uchegbu, 2016) showed a decrease in blood glucose levels in rats fed biscuits mixed with pigeon peas and plantains. In this study, there were six treatment groups where groups 1 and 2 served as the control group and were given standard rat feed, but group 2 was induced by alloxan. Groups 3-6 were diabetic rats that were fed biscuits. The results obtained from this study were a significant decrease in the group of rats that were given biscuits from a glucose level of 220 mg/dl to around 100 mg/dl, which showed the highest decrease, namely in group 4. This effect was an indirect result of total phenolic with increased antioxidant activity inhibition of carbohydrate digesting enzymes. In addition, the consumption of germinated pigeon peas reduced lipid peroxidation and decreased fasting blood glucose levels in diabetic rats. Important phytochemicals in pigeon pea seeds, such as phenolic acids, flavonoids, tannins, saponins, and phytic acid, cause these nuts to have high antioxidant activity and anti-diabetic and anti-inflammatory effects. Several studies explain the bioactive role of the protein fraction as an antihyperglycemic factor (Syed & Wu, 2018)

Danuyanti et al. (2019) gave DM model rats a pigeon pea tempeh powder formula for 14 days. The study showed that giving pigeon pea tempeh with a 75% formulation could reduce blood glucose levels to the highest by 44.08% compared to giving tempeh pigeon peas formulations of 25% and 50%. In line with the results of the study (Yusarini & Duniaji, 2019), which found a decrease in blood glucose levels in rats after being given pigeon pea tempeh, from 323.68 mg/dl to 200.37 mg/dl

Research on giving pigeon pea tempeh milk mixed with ginger to people with diabetes was reported (Suhaema & Cahyaningrum, 2017), with the result that there was a significant decrease in fasting blood glucose levels, namely from 207.3 mg/dL and 186.6 mg/dL ($p = 0.026$). Likewise, subsequent studies which gave a drink from a mixture of pigeon pea powder, ginger, and cinnamon resulted that fasting blood glucose levels decreasing from 227.3 mg/dl to 167.7 mg/dl after 14 days of intervention (Suhaema & Abdi, 2018). It was further explained that this effect could occur because pigeon pea contains the isoflavones cajanol and cajanin, which can lower blood glucose levels. In addition, pigeon pea also contains high fiber, calcium, and magnesium, with the amount per 100 grams sequentially being as much as 15.7 grams, 125 mg, and 104 mg (TKPI, 2009).

These pods' isoflavone genistein and genistin content function as antioxidants (Vanitha et al., 2016). Ka analysis results in. The dietary fiber content in functional pigeon pea, ginger, and cinnamon drinks was 22.25% db (Ariviani et al. (2018). Dietary fiber plays a role in controlling cholesterol and blood glucose levels. At the same time, exogenous antioxidants act as coenzymes that interact and synergize with cellular antioxidants to protect the body from free radical damage.

Pigeon pea is a source of antioxidants because it contains high phenolics. The pigeon pea seeds contain 3.82% phenols, 2.65% alkaloids, and 2.11% flavonoids (Sahu et al., 2014). In addition, pigeon pea also contains isoflavones (genistein and genistin) which function as antioxidants (Vanitha et al., 2016). The average levels of total fiber, and the total antioxidant and antioxidant activity of pigeon peas processed in the form of tempeh, respectively, were 9.15%, 41.30%, and 15% (Danuyanti et al., 2019)

A study (Shakappa et al., 2022) found a decrease in post-prandial blood glucose levels in rats given pigeon pea prebiotic feed from 30 minutes to 120 minutes. The highest decrease was obtained in the measurement after 120 minutes. This hypoglycemic effect is due to the beneficial intestinal microflora,

namely galactooligosaccharides as a prebiotic, which modulates the colonic microbiota and has been shown to significantly increase levels of bifidobacterium spp. and reduce the production of pathogenic bacteria.

CONCLUSIONS

Pigeon pea is a local food that is rich in nutrients, contains anthocyanins, and has high dietary fiber, which is beneficial for health. However, pigeon peas' antioxidant content and activity vary according to the processed form. In addition, this legume also contains other bioactive substances that have the potential to reduce blood glucose levels.

RECOMMENDATION

The results of this study can be used as an alternative healthy food that is beneficial for people with diabetes. However, needed further research about the maximum dosage and duration of pigeon pea consumption to avoid unwanted hypoglycemic effects.

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