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Porang (Amorphophallus Muelleri Blume) Effect Towards Blood Glucose in Diabetes Mellitus: A Systematic Review

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ABSTRACT

Background: Diabetes mellitus (DM) is an increasing global health problem. A high-sugar diet is one of the main factors causing DM. Porang tubers, containing glucomannan, have a low glycaemic index, can slow blood glucose absorption, reduce insulin spikes, and provide a longer feeling of fullness. Porang can be an alternative diet for people with diabetes mellitus. Objectives: To analyse the effect of porang administration on blood glucose levels in rat and human experimental trials.

Methods: This research method uses systematic literature review. A total of 239 articles used the keywords 'porang' OR 'Amorphophallus muelleri Blume' OR 'konjac glucomannan' AND 'blood glucose' OR 'blood sugar' AND 'diabetes mellitus' OR 'Diabetes' OR 'DM'. There were 5 experimental articles published through Scopus, PubMed, and Cochrane Library. The overall intervention treatment in experimental animals used porang with an average of 250 mg/kgBB for 21-28 days. Meanwhile, human respondents consumed porang for 12 weeks.

Results: Descriptive analysis conducted on various articles showed that the majority of porang administration in rat test animal subjects showed $p<0.05$ test results, which is a significant effect related to lowering blood glucose levels. Similarly, the results on human subjects showed a test result of $p<0.05$, which is a significant effect related to lowering blood glucose levels.

Conclusions: From the results of this study, it can be suggested that consuming porang-based foods with not a short period of time is effective in reducing blood glucose levels in patients with diabetes mellitus.

Keywords: Porang, Blood Glucose, *Amorphophallus muelleri Blume*, Diabetes Mellitus

1. INTRODUCTION

Diabetes mellitus (DM) is a chronic disease that is a global health problem. It is estimated that in 2021 there will be 536.6 million people with DM between the ages of 20-79 years, and it will increase every year (Sun *et al.*, 2022). Indonesia is predicted to have the seventh highest rate of diabetes mellitus in the world by 2030 (Rusminingsih and Purnomo, 2022). As many as one and a half million deaths in 2019 were caused by DM (WHO, 2023). DM is characterised by high blood sugar levels, much of which is caused by diet, especially eating foods containing sugar (Syauqy *et al.*, 2023).

Restriction of the number of calories and foods with low carbohydrates is the current choice of DM diet. However, this restriction causes people with DM to feel constantly hungry (Salvia and Quatromoni, 2023). According to research by Lukitaningsih et al., porang flour has a low glycaemic index of 20.6 (Lukitaningsih, 2015). Foods with a low glycaemic index have carbohydrates that are processed slowly by the body, resulting in a slow spike in blood glucose. Low sugar levels do not trigger

Porang tuber (*Amorphophallus muelleri Blume*) is an endemic plant in Indonesia that grows in many regions, especially Central Java (Wahidah, Afiati and Jumari, 2021). The most important content in porang tubers, glucomannan, has many benefits for DM disease (Zhang *et al.*, 2023). Glucomannan is stated to be beneficial because it improves blood glucose levels, reduces excess weight, and relieves constipation. The gel form of glucomannan can slow down intestinal absorption and insulin spikes (Wicaksono *et al.*, 2023). In this article, a systematic review will be used to find out what the benefits of porang for DM diseases are so that a food diet with porang-based ingredients can be considered for people with DM.

2. MATERIALS AND METHODS

2.1 Design and Time

The design of this study used a systematic review method on articles published from 2020 to 2024. The selection of research data is adjusted to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Page *et al.*, 2021). Data were obtained from Publish and Perish 8 and the Google Chrome search engine.

2.2 Data Collection

These articles were obtained from three search engines, namely Scopus, PubMed, and Cochrane Library. The keyword used in the search was diabetes mellitus (MeSH). The search was conducted using the Boolean operators 'OR' and 'AND', which are shown: ((((((Porang) OR (Amorphophallus muelleri Blume)) OR (Konjac Glucomannan)) AND (Blood Glucose)) OR (Blood Sugar)) AND (Diabetes Mellitus)) OR (Diabetes)) OR (DM)))))).

Eligibility criteria, including both inclusion and exclusion criteria, were applied in this study. The inclusion criteria for participation were as follows: 1) using experimental research design, 2) topics on porang and diabetes mellitus, 3) articles written in English, 4) using rats and humans as research subjects, 5) free full text published in national and international journals. Exclusion criteria: 1) incomplete research results, 2) literature not in accordance with the theme. The quality of the articles was assessed by the Critical Appraisal Skill Program (CASP) and after that the data will be extracted and synthesised using the PRISMA method (Long, French and Brooks, 2020; Page *et al.*, 2021).

3. RESULTS AND DISCUSSIONS

There were 239 articles in accordance with the research title, after which it was reduced by articles that were not included in the desired publication year, reduced to 126 articles. Then reduced duplication to 38 articles. Then after looking at the title and abstract, the article was reduced to 24 articles. The results of data extraction obtained 6 articles that fit the inclusion criteria. After that, the articles were filtered again based on free full-text journals and resulted in 5 articles that could be reviewed for discussion (Table 1).

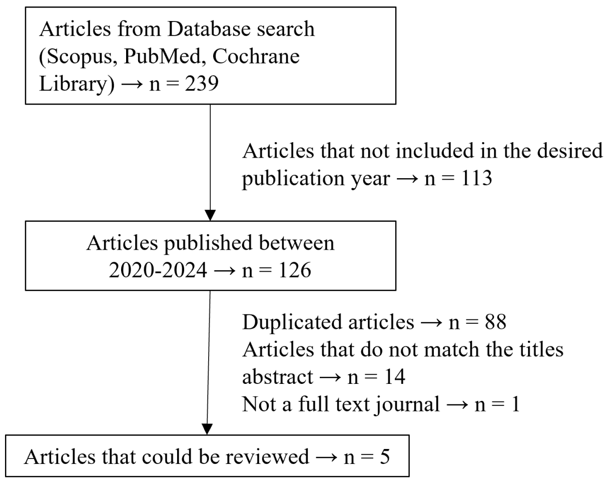

Figure 1. PRISMA Flow Diagram

3.1 Research Characteristics

In this study, data on research characteristics were presented for experimental trials of rats, mice, and humans (Table 1). The effect of porang on blood glucose levels in experimental animals was found in 5 research articles. All of the research articles were conducted in Indonesia and Japan. This study used the results of identifying blood glucose levels in experimental animals of rats, mice, and human respondents.

3.1.1 Porang Effect on Blood Glucose Levels in Experimental Rats

The effect of porang administration on blood glucose levels in experimental rats is described in detail in Table 2. Research by Fatchiyah et al. (Fatchiyah *et al.*, 2019), a one-month experiment conducted on Wistar rats, stated that glucomannan 0.12 g/kg BW is the optimum dose that is effective as an alternative to high-fibre therapy for patients with type 1 diabetes mellitus through the insulin receptor tyrosine kinase pathway.

Table 1. Research Characteristics Effect of Porang on Blood Glucose Levels

Reference	Year of Publication	Research Samples	Research Sites	Research Design	Research Materials	Outcomes
Fatchiyah., et al (Fatchiyah *et al.*, 2019)	2019	male wistar rats (weight ±150 grams)	Brawijaya University, Malang, Indonesia	Experimental	Amorphophallus muelleri Blume glucomannan fiber	blood glucose
Widjanarko., et al (Widjanarko *et al.*, 2023)	2023	male wistar rats (weight 150-200 grams)	Brawijaya University, Malang, Indonesia	Experimental	Porang Flour and Porang Flour Formulation	Fasting Plasma Glucose (FPG)
Sudjarwo., et al (Sudjarwo *et al.*, 2024)	2024	male mice (weight 20-40 grams)	Airlangga University, Surabaya, Indonesia	Experimental	Porang powder	blood glucose
Ueno., et al (Ueno *et al.*, 2023)	2021	Japanese patiens with T2DM	Department of Endocrinology, Metabolism, and Diabetes, Faculty of Medicine, University of Miyazaki Hospital; Department of Internal Medicine, Koga General Hospital; Department of Internal Medicine, Miyazaki Prefectural Miyazaki Hospital	Experimental	Konjac producs (various noodles, rice, desserts)	fasting plasma glucose levels
Liawidjaya., et al (Liawidjaya *et al.*, 2022)	2022	T2DM patients	Diponegoro National Hospital, Semarang, Indonesia	Experimental	Porang-processed rice (PR)	Fasting Blood Glucose (FBG) and 2 hours Post Prandial Glucose (2hPPG)

Table 2. Research Results of Porang Effect on Blood Glucose Levels in Experimental Test

Reference	n	Research Samples	Independent Variable			Duration	Dependent Variable/Outcomes	p-value
			Variable	Group	Intervention			
Fatchiyah., et al (Fatchiyah *et al.*, 2019)	20	male wistar rats (weight ±150 grams)	Amorphophallus muelleri Blume glucomannan fiber	Group 1	WT		Blood glucose 123.8 ± 19.8	
				Group 2	WT + 0.06g/kg BW	1 month	126.1 ± 18.8	$p < 0.05$
				Group 3	WT + 0.12g/kg BW		127.2 ± 18.1	
				Group 4	DM		274.4 ± 9.4	
				Group 5	DM + 0.06g/kg		300 ± 10.4	

					BW			
				Group 6	DM + 0.12g/kg BW		124.9 ± 8.2	
Widjanarko., et al **(Widjanarko *et al.*, 2023)**	28	male wistar rats (weight 150-200 grams)	porang flour (PF) and porang flour formulation (PFF)	Group 1 (Normal)	-		FBG 93.75±6.70	
				Group 2 (Control Negative)	-		357.80±95.60	
				Group 3	PF 300 mg/kg BW	4 weeks	115.25±10.40	$p < 0.05$
				Group 4	PFF 100 mg/kg BW		352.80±58.60	
				Group 5	PFF 300 mg/kg BW		134.50±43.10	
				Group 6	PFF 500 mg/kg BW		185.50±90.00	
				Group 7 (Control Positive)	Metformin 51.38 mg/kg BW		224.30±47.10	
Sudjarwo., et al **(Sudjarwo *et al.*, 2024)**	30	male mice (weight 20-40 grams)	porang powder	Group 1 (Control Negative)	0.3% CMC Na suspension		Blood glucose 354.0	
				Group 2 (Control Positive)	glibenclamide suspension 0.013 mg/20g/BW	21 days	114.2	$p < 0.05$
				Group 3	porang powder 85 mg/kg BW		112.7	
				Group 4	porang powder 165 mg/kg BW		110.8	
				Group 5	porang powder 250 mg/kg BW		109	
Ueno., et al **(Ueno *et al.*, 2023)**	26	Japanese patiens with T2DM	konjac products (various noodles, rice, desserts)	Intervention	30 servings of konjac products over 12 weeks. This included 2 packages of 175g cookable konjac plates, 8 packages of flavored konjac noodles, 8	12 weeks	Fasting plasma glucose (mg/dL) 152.8 ± 36.7	$p < 0.05$

					packages of konjac rice, 9 packages of 7 different seasoned konjac side dishes, and 3 packages of various konjac desserts			
Liawidjaya., et al **(Liawidjaya *et al.*, 2022)**	40	T2DM patients	porang-processed rice (PR) and white rice (WR)	WR group	200-500 grams per day	2 days	FBG 150.3 ± 59.03 2hPPG 192.2 ± 78.21	p > 0.05
				PR group	200-500 grams per day		FBG 128.8 ± 39.28 2hPPG 162.0 ± 71.46	p > 0.05

Diabetic rats given 0.12 g/kg BW of glucomannan fiber had significantly lower blood glucose levels compared to those given 0.6 g/kg BW. Conversely, the diabetic control group and the group given 0.06 g/kg BW showed significantly higher levels. Furthermore, the diabetic group given 0.12 g/kg BW demonstrated a reduction in blood glucose levels similar to the wild-type group. However, the wild-type group treated with glucomannan showed no significant difference compared to the untreated wild-type group.

Widjanarko et al.'s study (Widjanarko *et al.*, 2023) , an experiment conducted for 28 days on rats induced DM and treated with porang flour at 300 mg/kg body weight, including the middle-dose and high-dose formulations, demonstrated significantly lower fasting plasma glucose (FPG) levels ($p < 0.05$) compared to the diabetic control group. However, no significant difference ($p > 0.05$) in FPG was observed between these groups and the normal control group. In contrast, the low-dose porang flour formulation (100 mg/kg body weight) did not significantly alter FPG levels in diabetic rats compared to the untreated diabetic group. These findings suggest that the 300 mg/kg body weight dose of porang flour and the corresponding middle-dose formulation were more effective in reducing FPG levels.

Research by Sudjarwo et al. (Sudjarwo *et al.*, 2024), an experiment conducted for 21 days with an intervention in the form of glucomannan with a dose of 85, 165, and 250 mg/kg BW was able to reduce blood glucose levels in mice within 13 days, where the most significant decrease occurred on the fifth day when porang was given at a dose of 250 mg/kg BW in mice ($p<0.05$). The group given the porang powder intervention had similar effectiveness to the group given the positive control (glibenclamide) in the blood glucose examination conducted on day 21.

3.1.2 Porang Effect on Blood Glucose Levels in Human Experimental Tests

The effect of porang administration on blood glucose levels in experimental studies conducted on respondent subjects (humans) is described in full in Table 3. In Ueno et al.'s study (Ueno *et al.*, 2023) , an experiment was conducted on 26 Japanese people suffering from Type 2 DM, where all participants were required to consume konjac-based products (30 servings of konjac products over 12 weeks. This included 2 packages of 175g cookable konjac plates, 8 packages of flavored konjac noodles, 8 packages of konjac rice, 9 packages of 7 different seasoned konjac side dishes, and 3 packages of various konjac desserts). Following this 12-week intervention, a significant decrease ($p < 0.05$) in fasting blood glucose (FBG) levels was observed compared to pre-intervention levels.

Research by Liawidjaya et al. (Liawidjaya *et al.*, 2022), conducted experiments on 2 groups of humans suffering from diabetes mellitus, the first group was given white rice and the second group was given porang rice, both given ad libitum about 200-500 grams per day and observed for two days, then examined FBG and 2hPPBG. There was no significant difference in FBG and 2hPPBG between the two groups ($p>0.05$). Although there was a slightly greater reduction in FBG and 2hPPBG in the group given porang rice compared to the group given white rice, there was no significant difference in FBG and 2hPPBG between the two groups ($p>0.05$).

3.1.3 Glucomannan Effect on Blood Glucose

Based on the results of a systematic literature review on porang research, it states that porang administration can reduce blood glucose levels. Glucomannan contained in porang has the potential to regulate glucose metabolism through several mechanisms. One mechanism is by inhibiting the BCAA (Branched Chain Amino Acid) pathway. Glucomannan slows the absorption of BCAA, resulting in decreased mTOR and S6 Kinase activity. This decrease in activity has a positive impact on insulin sensitivity (Fang *et al.*, 2023). Glucomannan also increases the expression of IRS1 and PI3K, which are important components in the insulin signalling pathway. Thus, KGM may help increase glucose uptake into cells (Świderska *et al.*, 2020; Fang *et al.*, 2023).

Another mechanism is an increase in hexokinase activity and glycolysis. Hexokinase is an enzyme that plays a role in the process of glucose breakdown to produce energy. By increasing hexokinase activity, glucomannan helps to improve glucose utilisation by cells (Fang *et al.*, 2023).

Glucomannan also plays a role in decreasing gluconeogenesis, which is the process of forming new glucose from non-carbohydrate compounds. By inhibiting gluconeogenesis, glucomannan helps prevent uncontrolled increases in blood glucose levels. This is achieved through decreasing the activity of key enzymes in the gluconeogenesis process, such as glucose-6-biphosphate and fructose-1 (Fang *et al.*, 2023).

4. CONCLUSIONS

Based on the results of the analysis of five studies that fulfilled the inclusion criteria, it can be concluded that porang-based ingredients food can effectively reduce blood sugar levels if given in a longtime span. Therefore, it is recommended for people with diabetes mellitus to consume porang for a long period of time so that blood sugar levels decrease and are more stable.

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