Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi dan Biologi
Vol. 9, Issue 1, June 2026
Pages : 151 – 159

p-ISSN: 2621-3702
e-ISSN: 2621-7538

Phytochemical characterization and antihyperglycemic activity of kemumu (*Colocasia gigantea* Hook. f.) leaf stalk juice in glucose-loaded mice (*Mus musculus* L.)

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ABSTRACT

Kemumu leaf stalk juice (*Colocasia gigantea* Hook. f.) is traditionally used to control blood sugar levels. However, scientific evidence is still limited and further studies are required for this purpose. This study aims to analyze the phytochemical content and test the ability of kemumu leaf stalk juice to reduce blood sugar levels in glucose-loaded mice. Secondary metabolites examined included tannins, alkaloids, phenolics, saponins, steroids, triterpenoids, and flavonoids. The antihyperglycemic activity was evaluated using 20 adult male mice (*Mus musculus* L.) as an animal model. First, fasting blood sugar levels were measured, then the mice were given 50% glucose. After 30 minutes, blood sugar levels were measured again. The mice were divided into 5 groups: 2 control groups and 3 treatment groups. The negative control group mice received 0.2 ml of distilled water, and the positive control group mice received glibenclamide at 0.65 mg/kg BW. Mice in treatment groups 1, 2, and 3 were given 0.05 ml/20 g BW, 0.1 ml/20 g BW, and 0.2 ml/20 g BW of kemumu juice, respectively. Blood sugar levels were measured every 30 minutes for up to 180 minutes. Data were analyzed using ANOVA, and if significant differences were found, an LSD test was performed. The results showed that kemumu juice contains alkaloids, phenolics, and flavonoids, which have antidiabetic properties. Doses of 0.1–0.2 ml were as effective as glibenclamide in the positive control group.

Keywords: Diabetes, glibenclamide, kemumu, mice, phytochemicals

INTRODUCTION

The prevalence, morbidity, and mortality of diabetes pose significant problems worldwide, including in Indonesia. Globally, an estimated 463 million adults aged 20-70 years have diabetes. This number is expected to increase to 578 million worldwide by 2030 (Muharram et al., 2025). Diabetes is a metabolic disorder characterized by hyperglycemia or high blood sugar (Pertiwi et al., 2021). Insulin is key to maintaining normal blood glucose levels (Shehadeh et al., 2021).

Uncontrolled high blood sugar can result in complications such as ulcers, kidney failure, and others. It is possible to manage hyperglycemia using either conventional or herbal remedies (Muttaqien & Purnama, 2023). To maintain normal blood sugar levels, people with diabetes take conventional medications such as metformin (MET), thiazolidinediones (TZDs), sulfonylureas (SUFs), dipeptidyl peptidase 4 (DPP-4) inhibitors, glucagon-like peptide-1 (GLP-1) inhibitors, and sodium-glucose cotransporter-2 (SGLT-2) inhibitors (Davies et al., 2022). However, long-term use can cause unexpected side effects (Lee et al., 2021). Therefore, there is growing interest in identifying plant-derived therapeutic agents that can control blood sugar levels while having fewer side effects.

Several natural substances have been shown to help regulate hyperglycemia or function as antidiabetic agents, including Bee Poleen *Trigona incisa* (Kurniati et al., 2024), cat's whiskers (*Orthosiphon aristatus*), cherries (*Muntingia calabura*), and Green chiretta (Utami, 2003), as well as Kemumu leaf stalk extract (Kurniati et al., 2012).

Kemumu (*Colocasia gigantea* Hook.f) is often referred to as Padang taro. The tubers of kemumu can be used as a medicine to relieve drowsiness, fever, and to heal infections and wounds (Asri et al., 2019). Leaf extract is known to contain antidiarrheal, antimicrobial, and antioxidant properties (Alam et al., 2021). The results of in vitro tests showed that the extract of taro leaf stems (*Colocasia gigantea* Hook. f.) was active as an antidiabetic because it could inhibit the activity of the α-glucosidase enzyme targeted at an IC50 value of <100 µg/mL.ppm of 98.35% with an IC50 value of 31.5670 ppm (Marliza et al., 2021).

Meanwhile, the juice from leaf stalks is often used empirically to lower blood sugar levels. Kurniati et al. (2012) research indicated that kemumu leaf stalk extract reduces blood sugar levels in glucose-loaded mice more effectively than conventional drugs like glibenclamide.

Fresh leaf stalk juice is traditionally consumed to lower blood sugar, not an extract (Kurniati, 2012). It is unknown whether the phytochemical content of kemumu leaf stalk juice is the same as that of kemumu leaf stalk extract, or whether its effectiveness is the same. Therefore, it is necessary to research phytochemical screening and the effect of administering kemumu (*Colocasia gigantea* Hook. f) leaf stalk juice on lowering blood sugar levels in mice (*Mus musculus* L.) fed glucose. If it is proven to be effective, this approach may facilitate the development of herbal medicinal formulations that are more convenient and practical for patient use.

METHOD

Animal model

Twenty healthy male mice, weighing approximately 20 grams each, were obtained from the Animal Physiology, Development, and Molecular Laboratory of Mulawarman University. Before the study was conducted, the mice were adapted for a week in a laboratory environment with a temperature of 26-28°C and lighting of 12 hours of light and 12 hours of darkness. During acclimatization, mice were given pellet feed and water as much as they wanted according to standard maintenance procedures (Primiani et al., 2025).

Preparation of kemumu leaf stalk juice

The Kemumu leaf stalks were washed, then chopped into small pieces. The samples were put into a juicer without added water. The juice obtained was then prepared for phytochemical analysis and administered to mice.

Phytochemical screening of kemumu leaf stalk juice

Phytochemical screening was performed to identify secondary metabolites, including alkaloids, saponins, steroids, triterpenoids, flavonoids, and phenolics, following standard laboratory protocols (Harborne, 1987).

Treatment with kemumu stem juice and blood sugar level measurement

The mice fasted for 16 hours before their blood sugar levels were measured. Each group of mice was then given 0.5 mL of 50% glucose orally. After 30 minutes, their induced blood sugar levels were measured. They were then given the appropriate treatment for their respective groups.

The mice were divided into five groups, each consisting of four mice. Mice from the negative control group were given distilled water, and mice from the positive control group were given glibenclamide at 0.65 mg/kg BW. The three treatment groups were: Treatment I, receiving 0.05 ml/20 g BW of kemumu leaf stalk juice; Treatment II, receiving 0.1 ml/20 g BW of kemumu leaf stalk juice; and Treatment III, receiving 0.2 ml/20 g BW of kemumu leaf stalk juice.

The blood sugar levels of each mouse were measured at 30, 60, 90, 120, 150, and 180 minutes after treatment. Blood sugar levels were determined using the Glukotest tool (SinoheartTM). Blood samples were obtained by pricking the tail with a sterile lancet, allowing the blood to flow onto the glucose strip attached to the Glukotest tool. The tool was then left for 10 seconds, after which it automatically displayed the blood sugar level in mg/dL (Kurniati et al., 2024).

Data analysis

Blood sugar level data from mice were analyzed using SPSS version 23. The data were first tested for normality and homogeneity; if the p-value is greater than 0.05, the data are considered normally distributed and homogeneous. Homogeneity was assessed using a one-way ANOVA. If the p-value is less than 0.05, there are differences among treatments. An LSD test was then used to determine which treatments differed significantly. If the normality and homogeneity tests yield p-values above 0.05, the Kruskal-Wallis test is conducted, followed by the Mann-Whitney test (Rahmaniyah, 2018).

RESULTS AND DISCUSSION

Kemumu leaf stalk juice phytochemical composition

Phytochemicals are chemical compounds found naturally in plants. These phytochemicals often possess health benefits for humans, including antioxidant, anti-inflammatory, and antimicrobial properties, making them important in the development of medicines and health foods.

Table 1 shows that the kemumu leaf stalk juice contains alkaloid, phenolic, and flavonoid compounds. When compared with the kemumu leaf stalk extract (Kurniati et al., 2012), there is one compound, namely triperpenoid, contained in the extract, but not found in the kemumu leaf stalk juice. The difference in content is due to the nonpolar nature of triperpenoids, which are more soluble in organic solvents, such as ethanol, than in water, which is a polar solvent. According to Pote et al. (2024), the statement indicates that the solvent concentration of triperpenoids influences the content of extracted secondary metabolites. Additionally, both the type and amount of solvent impact the extracted active compounds, following the principle of "like dissolves like," which means polar compounds dissolve in polar solvents and nonpolar compounds in nonpolar solvents.

Table 1. Characterization of Kemumu (*Colocasia gigantae* Hook. f.) leaf stalk juice.

Content	Leaf Stalk Juice	Leaf Stalk Extract
Alkaloids	+	+
Tannin/saponin	-	-
Phenolic	+	+
Triterpenoid	-	-
Steroids	-	-
Flavonoids	+	+

Description:
(+) = contains the substance examined
(-) = no contains substances examined
Leaf stalk extract content sourced from Kurniati et al. (2012)

Alkaloids are one of the contents of kemumu leaf stalk juice. Studies have shown that alkaloids exert antidiabetic effects by stimulating insulin secretion, inhibiting gastrointestinal enzymes, preventing AGEs, and increasing glucose absorption. They also suppress α-glucosidase and α-amylase, reducing post-meal hyperglycemia (Gautham et al., 2025).

Phenolics can play a fundamental role in diabetes management, as they can lower blood glucose levels, oxidative stress, and protein glycation. In addition, they can also inhibit the activity of dipeptidyl peptidase IV and other enzymes related to carbohydrate metabolism. Phenolics can activate various biochemical pathways to improve pancreatic β-cell function, increase insulin secretion, and improve insulin resistance (de Paulo Farias et al., 2021)

Additionally, alkaloid and phenolic compounds can lower blood sugar levels by inhibiting carbohydrate-digesting enzymes such as α-amylase and glucoamylase. One example of a plant containing alkaloids and phenolics that can inhibit the α-amylase and glucoamylase enzymes is *Chromolaena odorata* (Gaspersz et al., 2022).

Flavonoids are a type of secondary metabolite that belongs to the polyphenol group found in plants. Additionally, flavonoids exhibit health benefits such as anti-cardiovascular, antidiabetic, antiobesity, and anticancer effects in humans (Cahyana & Adiyanti, 2021). Flavonoids, a phytochemical present in the juice of the kemumu leaf stalk, have been demonstrated to reduce blood sugar levels. Other plants containing flavonoids that are effective in lowering blood sugar include *Anredera cordifolia*, Moringa, and *Muntingia calabura* (Safna et al., 2021; Chairul et al., 2024).

Another example is *Tinospora crispa*, a plant rich in alkaloids and flavonoids, which has been shown to reduce blood sugar levels in diabetic mice. The plant extract at a dose of 300 mg/kg BW exhibited greater antidiabetic activity than the commercial drug glimepiride (Hasan et al., 2024).

The phytochemical screening results indicate that kemumu leaf stalk juice contains alkaloids, phenolics, and flavonoids. Sukhikh et al. (2023) stated that all of these phytochemicals have been shown to have antidiabetic properties, so the juice of the kemumu leaf stalks has the potential to be an effective antidiabetic agent.

Blood sugar levels

Blood sugar level measurements were carried out during fasting, after being induced with 50% glucose, and continued for 30-180 minutes. The average was calculated to assess the effect of administering the kemumu leaf stalk juice as a whole during the study.

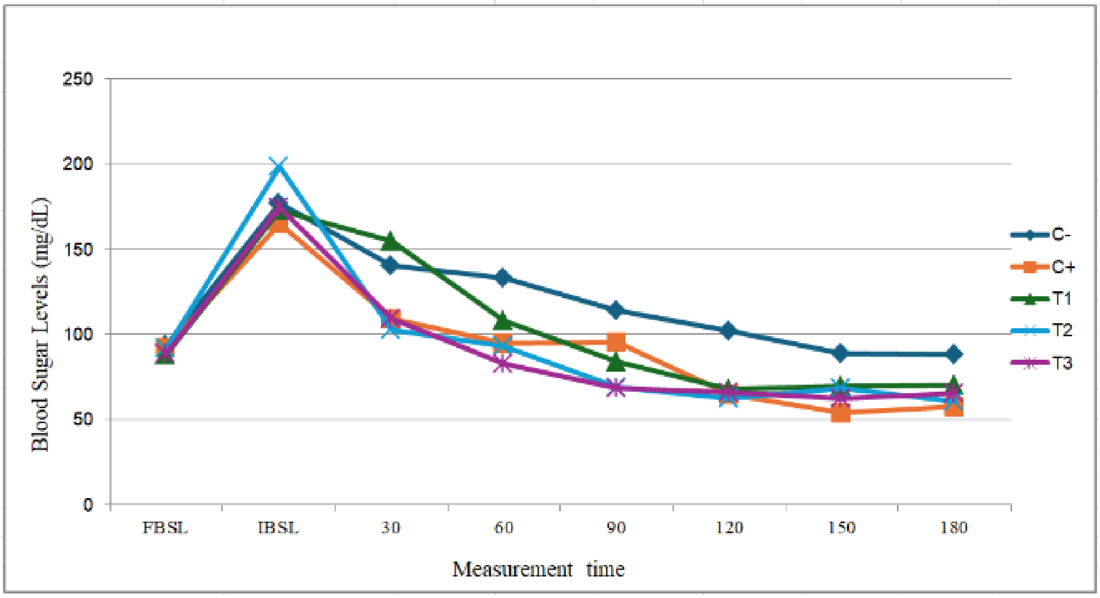

Figure 1. Fasting blood sugar levels, 50% glucose induction, and measurements every 30 minutes after treatment (30-180 minutes). FBSL (Fasting Blood Sugar Levels), Induced Blood Sugar Levels (IBSL). C-: Negative control; C+: positive control; T1: treatment with 0.05 ml kemumu leaf stalk juice; T2: treatment with 0.1 ml kemumu leaf stalk juice, and T3: treatment with 0.2 ml kemumu leaf stalk juice.

Fasting Blood Sugar Levels (FBSL) across all groups were similar, indicating that the conditions of all test animals were relatively homogeneous (Figure 1). FBSL in all test animals ranged from 88 to 93 mg/dL, which is nearly in line with normal FBSL standards. According to Fu et al. (2024), normal fasting blood sugar levels in mice range from 65 to 90 mg/dL.

Induced Blood Sugar Levels (IBSL) in all test animals ranged from 165 to 198 mg/dL. Blood sugar levels increased across all groups compared with the FBSL group, but this was not considered hyperglycemia. According to Sindi et al. (2022) and Putra et al. (2022), hyperglycemia is defined as blood sugar levels of 200 mg/dL or higher 2 hours after eating.

Glucose-loaded mice experience a rapid increase in blood glucose levels. Peak blood sugar levels generally occur 15–30 minutes after glucose administration. Blood sugar levels begin to decline due to insulin secretion and generally return to near basal levels within 90–120 minutes in normal mice (Moro & Magnan, 2025). Blood glucose levels in normal mice fed freely are generally in the range of 120–150 mg/dL (Kennard et al, 2022).

Blood sugar levels were measured 30 minutes after treatment. Figure 1 shows that the T1 group and the negative control group (C-) had higher blood sugar levels than the other groups. This indicates that the T2, T3, and C+ treatments reduced blood glucose levels at the 30th minute after treatment. Within the 60-180 minute timeframe, all treatment groups and the positive control showed a larger reduction in blood glucose levels than the negative control group. This indicates that the juice of the kemumu leaf stalk has the potential to lower blood glucose levels, as well as the positive control using the commercial drug glibenclamide.

Glibenclamide is a synthetic oral antidiabetic drug that stimulates the beta cells of the pancreas (Langerhans islets) to produce insulin, thereby lowering blood glucose levels Liem et al. (2015). This drug works by inhibiting the KATP channel that targets the regulatory subunit of the sulfonylurea receptor (SUR). Sulfonylureas such as glibenclamide bind tightly to plasma proteins, and as a consequence, the effective concentration in plasma is much lower than the total concentration (Sahin et al., 2024).

Table 2. Average fasting blood sugar levels, induction with 50% glucose, and after treatment with kemumu leaf stalk juice in the 30-180th minute.

Groups	FBSL	IBSL	Average of BSL 30-180th minutes
C-	93.60±1.36a	176.80±6.88a	111.20±10.93b
C+	92.60±1.36a	165.20±10.81a	79.43±4.80a
T1	88.20±3.86a	172.60±3.86a	92.33±6.56ab
T2	91.60±1.88a	198.80±10.19a	74.36±5.71a
T3	88.80±2.33a	174.40±6.93a	75.76±3.15a

Description:
FBSL = Fasting Blood Sugar Levels;
IBSL = Induced Blood Sugar Levels;
BSL = Blood Sugar Levels;
C- = negative control;
C+ = positive control;
T1 = treatment with 0.05 ml kemumu leaf stalk juice;
T2 = treatment with 0.1 ml kemumu leaf stalk juice, and
T3 = treatment with 0.2 ml kemumu leaf stalk juice.
Different notations in the same column indicate significantly different mean values in the LSD test at a 95% confidence level.

Table 2 shows the average blood sugar levels after treatment measured from the 30th to the 180th minute. Mice in the T2 and T3 groups treated with *Colocasia gigantea* leaf stalk juice exhibited significantly lower blood glucose levels than those in the negative control (C−) group, indicating a pronounced hypoglycemic effect. No significant differences in blood glucose levels were observed between the T2 and T3 groups and the positive control (C+) group treated with glibenclamide. These findings suggest that administration of *Colocasia gigantea* leaf stalk juice at doses of 0.1 mL and 0.2 mL produced a hypoglycemic effect comparable to that of glibenclamide in glucose-loaded mice.

Boiled red betel leaf water administered at doses of 0.4–0.5 mL/20 g body weight significantly reduced blood glucose levels in diabetic mice compared with untreated controls. The antihyperglycemic activity is thought to be associated with the presence of flavonoids, alkaloids, and phenolic compounds, which have been reported to inhibit α-glucosidase activity and contribute to the regulation of blood glucose levels (Wiliam et al., 2025).

Glibenclamide is a second-generation sulfonylurea that lowers blood glucose levels by increasing insulin secretion from pancreatic beta cells (Mohseni et al., 2022). Its mechanism of action involves promoting insulin release from pancreatic beta cell granules by interacting with ATP-sensitive potassium channels on the cell membrane. This interaction opens Ca2+ ion channels, allowing Ca2+ ions to enter the beta cell and subsequently stimulate insulin release (Widyastuti et al., 2025). The comparable potential of kemumu leaf stalk juice to glibenclamide in lowering blood glucose levels suggests it as a potential substitute for currently used synthetic antidiabetic drugs.

CONCLUSION

Kemumu leaf stalk juice contains alkaloids, phenolics, and flavonoids. Treatment with a dose of 0.1-0.2 ml was as effective as glibenclamide used in the positive control group. Kemumu (*Colocasia gigantea* Hook. f.) may have potential as a complementary herbal preparation, although further studies are required. Preparations in the form of fresh juice from kemumu leaf stalks are just as effective as extracts and are easier for people to consume.

ACKNOWLEDGMENT

We sincerely acknowledge the Financial support provided by the PNBP research funding scheme from the Faculty of Mathematics and Natural Sciences, Mulawarman University.

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