

Gas Chromatography-Mass Spectroscopic Profile, *In vitro* Antidiabetic and Radical Scavenging Potentials of *Polyalthia longifolia* leaf phenolic extract

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ABSTRACT

Reactive radicals are pivotal in the pathogenesis and progression of many diseases including diabetes mellitus. Medicinal plants are globally recognized as viable alternative sources of bioactive compounds for the management of such diseases. *Polyalthia longifolia* (Masquerade tree) remains relatively untapped for therapeutic bioactive compounds for the management of diabetes mellitus. This study aimed to evaluate the radical scavenging and antidiabetic potentials of *Polyalthia longifolia* leaf phenolic extract (PLLPE) *in vitro*. PLLPE was obtained by soaking 150 g of the air-dried pulverized leaf of *P. longifolia* in 1500 ml of two-phase solvent system (ethyl acetate, acetic acid and water 3:1:6 v/v/v) for 1 hour as described in literature. This yielded 1.3 g of crude phenolic extract, equivalent to 0.92 %w/w. α -amylase and α -glucosidase inhibitory activity of the extract and nitric oxide, 2,2-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) radical (ABTS*), 2,2-diphenyl-1-picrylhydrazyl radical (DPPH*), and hydroxyl radical scavenging potentials were assayed using standard methods with acarbose and butylated hydroxytoluene (BHT) as standards. The gas chromatography-mass spectrometric (GCMS) profile of the extract was also determined. The percentage radical scavenging and inhibitory activities of PLLPE increased with concentration across the parameters determined. The IC₅₀ for the inhibition of α -amylase by the PLLPE was lower (269.712 μ g/ml) compared to acarbose (434 μ g/ml) while the IC₅₀ for the inhibition of α -glucosidase by the PLLPE was higher (122.64 μ g/ml) compared to acarbose (45.60 μ g/ml). Though the percentage radical scavenging activity of PLLPE increased with concentration, it only possessed a lower SC₅₀ for scavenging against hydroxy radical (178 μ g/ml) compared to BHT (337.40 μ g/ml). GCMS analysis of the extract revealed thirty-one compound peaks, out of which 2,3-dihydro-2-Benzofuran, (34.33), 2,3-dihydro-3,5-dihydroxy-6-methyl- 4H-Pyran-4-one (10.40), Methoxyacetic acid, 2-propenyl ester (7.29) and 2-Pyridinecarboxaldehyde (5.72) were the most abundant. Thus, PLLPE contains promising constituents for the management of diabetes mellitus.

Keywords: *Polyalthia longifolia*, free radicals, α -amylase, α -glucosidase, diabetes mellitus

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Introduction

In diabetes mellitus, hyperglycaemia enhances formation of reactive oxygen species (ROS)/free radicals which results in auto-oxidation of membrane bound macromolecules (lipids and proteins) and eventually, cellular damage (ADA, 2018). Formation of reactive free radicals has been directly linked to secondary complications in diabetes mellitus (Kajaria *et al.*, 2013).

Antioxidants are entities of natural or artificial sources that can protect cells against the damaging oxidizing effects of free radicals. Oxidative stress results in cells when the rate of free radicals' production overwhelms the innate antioxidant capacity of natural antioxidants. Thus, nutrient-derived or ingested antioxidants have been shown to complement the innate antioxidants in the prevention of the havoc of free radicals on cellular components and processes (Akinmoladun *et al.*, 2010; Sabiu *et al.*, 2016; Liu and Ma, 2017).

α -Glucosidase and α -amylase inhibitors make up a class of antihyperglycemic drugs whose therapeutic benefits in diabetes mellitus relies on their role in keeping postprandial glucose levels in check to enable desirable glycemic control (Beckman and Creager, 2016). Such control has been shown to be essential in preventing the progress of impaired glucose tolerance toward type 2 diabetes by decreasing the incidence of hyperglycemia and hyperinsulinemia, thus reducing insulin resistance and stress on the β -cells of the pancreas (Bacha *et al.*, 2010). Several synthetic carbohydrate metabolizing enzyme inhibitors are currently in clinical use such as acarbose, miglitol, and voglibose. However, the longtime use and administration of these drugs at high dose are known to cause adverse effects such as diarrhea, abdominal pain, flatulence, and abdominal or stomach pain due, in part, to the absoluteness of their inhibition of alpha glucosidase (Thouri *et al.*, 2017).

Traditional herbal medicines have shaped the basis of human health care, and further research will improve global health. Presently, about 80% of the world population (according to WHO) uses herbal drugs for some aspects of primary health care. Natural product-derived antidiabetic

therapies are now becoming increasingly acceptable due to the financial inaccessibility and side effects connected with some synthetic antidiabetic drugs (Rahman *et al.*, 2022). The herbal preparations are complementary and considered more accessible alternative. The search for the discovery of novel compounds derived from natural sources like herbs or plant is growing mainly due to acquired resistance, side effects, and adverse events of synthetic antidiabetic drugs.

In search of new medicinal plants that pose concurrent antioxidant and antidiabetic activity, *Polyalthia longifolia* phenolic plant extract was considered. The genus *Polyalthia* includes about 120 species occurring mainly in Africa, South and South-Eastern Asia, Australia, and New Zealand (Lavanya *et al.*, 2018). Almost all parts of this plant are used in Indian traditional system for the treatment of various ailments and the significant medicinal properties was further reported through scientific investigation (Ojewuyi *et al.*, 2014). A recent study by Anigboro *et al.* (2018) revealed the presence of numerous phytochemicals including phenolics compounds which has placed *Polyalthia longifolia* as a source of phenolics. Phenolic compounds are known to elucidate antioxidant, anticarcinogenic, or antimutagenic and anti-inflammatory effects (Pereira *et al.*, 2009).

This study was therefore conceptualized to evaluate the potential of *Polyalthia longifolia* leaf crude phenolic extract to scavenge toxic free radicals and mitigate postprandial hyperglycemia through the inhibition of select carbohydrate-metabolizing enzymes *in vitro*.

Materials and Methods

Reagents and Chemicals

Alpha amylase, alpha glucosidase, 2,2-diphenyl-1-picrylhydrazyl (DPPH), and 2, 2-azinobis-(3-ethylbenzthiazoline-6-sulfonic acid (ABTS) were products of Sigma Aldrich. All other chemical reagents used were of analytical grade and were prepared in glass wares.

Plant Material

Fresh leave sample of *Polyalthia longifolia* plant was obtained from environs of Basin, Ilorin

South, Kwara State, Nigeria. The plant was identified and authenticated in the Plant Biology Department of University of Ilorin, Ilorin, where a voucher (UILH/001/872/2021) was allocated. Thereafter, the dried leaves were blended into even and fine particles, and were stored at room temperature until use.

***Polyalthia longifolia* Phenolic Extraction**

The process of phenolics extraction commenced by the preparation of the biphasic solvent system. The two-phase solvent system was prepared by mixing ethyl acetate, acetic acid and water in ratio 3:1:6 (300 ml of ethyl acetate, 100 ml of acetic acid and 600 ml of water) into a separating funnel, at 20°C. The obtained biphasic system was thoroughly agitated, and then left in contact till mutual saturation of the two phases. The polar and organic phases were separated just before their use.

Masquerade tree leaves (100 g) were added to 1L of the aqueous phase of the solvent system. The obtained suspension was put immediately in the vessel and mixed with 600 ml of the organic phase during 30 min at room temperature. The macerations were carried out in a mechanically stirred vessel. The obtained suspensions were then, filtered through Whatman No 1. filter paper in a glass vacuum Buchner funnel. The filtrate was concentrated to dryness using rotary evaporator at 78°C, then a water bath at 40°C. The crude extract obtained was transferred in sterile 20 ml plain bottles and stored in refrigerator at 4°C prior to usage.

DPPH radical scavenging assay

The potential of *Polyalthia longifolia* leaf phenolic extract to bleach the purple-coloured methanol solution of 2,2-diphenyl-1-picrylhydrazyl (DPPH) was determined as described by Turkoglu *et al.* (2007). Briefly, 1 ml of various concentrations (7.81– 1000 µg/ml) of the extract in methanol was added to 1 ml of a 0.2 mmol/L sample of DPPH in methanol. After a 30 min incubation period at room temperature, the absorbance was read against blank at 516 nm. Inhibition rate (I%) on the DPPH radical was calculated using the expression:

Percentage inhibition (I%) =

$$\frac{(\text{Absorbance of control} - \text{Absorbance of extract}) \times 100}{\text{Absorbance of control}}$$

Nitric oxide scavenging assay

Nitric oxide radical scavenging activity of *Polyalthia longifolia* leaf phenolic extract was assayed according to the method of Liu *et al.* (2013). Briefly, 2 ml of 10 mM sodium nitroprusside in 0.5 ml phosphate buffer saline (pH 7.4) was mixed with 0.5 ml of varying concentrations of the extract (7.81– 1000 µg/ml) and incubated at 25 °C for 2 h. From the incubated mixtures, 0.5 ml were taken and added to 1 ml sulfanilic acid reagent (33% in 20% glacial acetic acid) and further incubated at room temperature for 5 min. Following this, 1 ml naphthylethylenediamine dihydrochloride (0.1% w/v) was introduced into the mixtures and the resulting solution incubated at room temperature for 30 min. The absorbance was taken at 540 nm. Percentage scavenging (S%) was calculated using the expression:

Percentage Scavenging (S%) =

$$\frac{(\text{Absorbance of control} - \text{Absorbance of extract}) \times 100}{\text{Absorbance of control}}$$

ABTS radical scavenging Assay

This method is based on the ability of an antioxidant to stabilize the ABTS green-blue ABTS chromophore, which is formed by the reaction ABTS (2, 2-azinobis-(3-ethylbenzthiazoline-6-sulfonic acid) and potassium persulfate (Nenadis *et al.*, 2004). Varying concentrations of the extract (7.81– 1000 µg/ml) of the extract was prepared using ethanol as a diluent. ABTS^{•+} solution was generated by mixing 7 mM ABTS and 2.45 mM potassium persulfate (K₂S₂O₈) in water, which was placed in the dark at room temperature for 16 h to give the complete oxidation of ABTS. Before using, the ABTS^{•+} solution was reconstituted by dilution with water to get an absorbance of 0.700 ± 0.050 at 734 nm. Briefly, 1 ml of ABTS^{•+} solution was added to 30 µl of test samples and mixed thoroughly. The reactive mixture was incubated at room temperature for 6 min and the absorbance was immediately recorded at 734 nm. Inhibition rate (I%) on the ABTS radical was calculated using the expression:

$$\text{Percentage inhibition (I\%)} = \frac{(\text{Absorbance of control} - \text{Absorbance of extract}) \times 100}{\text{Absorbance of control}}$$

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Hydroxyl radical Scavenging Assay

Different concentration of extracts (7.81– 1000 µg/ml) was incubated with 0.25ml of 2 mM EDTA-Fe ,0.25 ml of 3% H₂O₂ in 2.25 ml of sodium phosphate buffer (150 mM, pH 7.4) for 30minutes, Centrifuge at 7450rpm for 5minutes. Hydroxyl radical was detected by monitoring absorbance at 520 nm. Percentage scavenging (S%) was calculated using the expression:

$$\text{Percentage Scavenging (S\%)} = \frac{(\text{Absorbance of control} - \text{Absorbance of extract}) \times 100}{\text{Absorbance of control}}$$

α -amylase inhibition assay

Adopting the methods of Elsnoussi *et al.* (2012) and Sabiu *et al.* (2016), the α -amylase inhibitory activity was evaluated. Briefly, varying concentrations (12.5– 200 µg/mL) of the extract were prepared and 500 ml of each was mixed with 500 ml of 0.02 m sodium phosphate buffer (pH 6.9) containing 0.5 mg/ml of α -amylase solution and incubated in test tubes at 25 °C for 10 min.

After pre-incubation, 500 ml of 1% starch solution in 0.02 m sodium phosphate buffer (pH 6.9) was added to each tube at timed intervals. The reaction mixtures were incubated at 25 °C for 10 min and stopped with 1.0 ml of dinitrosalicylic acid reagent. The tubes were then incubated in a boiling water bath for 5 min and subsequently cooled to room temperature. The reaction mixtures were then diluted with distilled water (15 ml), and the absorbance readings were measured at 504 nm and the values compared with a control which contained 500 ml of the buffer instead of the extracts. Acarbose was prepared in distilled water at same concentrations as extracts and used as control. The experiments were conducted in triplicate and the α -amylase inhibitory activity was expressed as percentage inhibition.

$$\text{Percentage inhibition (I\%)} = \frac{(\text{Absorbance of control} - \text{Absorbance of extract}) \times 100}{\text{Absorbance of control}}$$

α -glucosidase inhibition assay

The α -glucosidase inhibitory activity was assayed following the method of Elsnoussi *et al.* (2012). In brief, different concentrations (12.5– 200 µg/ml) of CS were prepared in distilled water. Then, 50 ml from the stock solution was mixed with 100 ml of 0.1 m phosphate buffer (pH 6.9) containing 1.0 m of α -glucosidase solution. The mixtures were then incubated in 96-well plates at 25 °C for 10 min. Following this, 50 ml of 5 mM p-nitrophenyl- α -Dglucopyranoside solution in 0.1 m phosphate buffer (pH 6.9) was added to each well at timed intervals. The reaction mixtures were incubated at 25 °C for 5 min. The absorbance readings were thereafter taken at 405 nm using a micro-plate reader (Thermomax, USA) and the values compared with a control which contained 50 ml of the buffer instead of the extract. Acarbose (Bayer Medicals, Germany) was prepared in distilled water at same concentrations as the extract and used as control. The experiments were conducted in triplicate and the α -glucosidase inhibitory activity was expressed as %inhibition using the expression:

$$\text{Percentage inhibition (I\%)} = \frac{(\text{Absorbance of control} - \text{Absorbance of extract}) \times 100}{\text{Absorbance of control}}$$

Identification of Components

Interpretation of the GC MS mass spectrum was conducted by comparing the peak retention time, peak area (%), height (%) and mass spectral fragmentation patterns of the peaks to that of the known compounds described by the National Institute of Standards and Technology (NIST) library. The name, molecular weight and molecular formular of the components of *Polyalthia longifolia* leaf phenolic extract were ascertained. The relative percentage amount of each component was calculated by comparing its average peak area to the total area (Konappa *et al.*, 2020).

Data Analysis

Data were expressed as mean value $\pm$ standard deviation of three replicates (n = 3) experiments. The analysis of variance for differences between means to determine significant differences, IC₅₀

and SC₅₀ were computed using Graph-pad prism 6.

Results

Radical scavenging activities of *Polyalthia longifolia* leaf phenolic extract

The *in vitro* antioxidant potentials of *Polyalthia longifolia* leaf phenolic extract are shown in Figures 3, 4, 5 and 6. The antioxidant activities were determined with reference to BHT as standard. The extract concentration-dependently scavenged the generated radicals in all the assays investigated. Nitric oxide is unstable and reacts with molecular oxygen to form stable nitrate. *Polyalthia longifolia* leaf phenolic extract exhibited commendable nitric oxide scavenging effect (with 850 µg/ml IC₅₀ value) in comparison with Butyl Hydroxytoluene (719 µg/ml) (Figure 1). The capability of the extract to scavenge OH radical revealed a remarkable effect also judging by the IC₅₀ value (178 µg/ml) when compared with silymarin (337.40 µg/ml) (Figure 2).

Similarly, ABTS inhibition ability of *Polyalthia longifolia* leaf phenolic extract revealed a significant potential (Figure 3), an IC₅₀ value of 212.2 µg/ml and 157.23 µg/ml was recorded for the extract and Butyl Hydroxytoluene (BHT) respectively. Furthermore, the capability of the extract to scavenge DPPH radical revealed a promising effect judging by the IC₅₀ value (227.47 µg/ml) when compared with BHT (85.90 µg/ml) (Figure 4).

Antidiabetic activities of *Polyalthia longifolia* leaf phenolic extract

The results of α-glucosidase inhibitory assay revealed that the activities of α-glucosidases were dose-dependently inhibited by *Polyalthia longifolia* leaf phenolic extract (Figure 5), compared with acarbose, the IC₅₀ value revealed a promising inhibition with 122.64 µg/ml and 45.50 µg/ml respectively. The most potent effect was observed with the extract at the highest dose investigated, while the lowest concentration of 12.5 µg/ml revealed minimum inhibition. Interestingly, α-amylase were dose-dependently inhibited by *Polyalthia longifolia* leaf phenolic extract better than Acarbose (Figure 6) which was evident with a lower IC₅₀ value when compared with Acarbose. An IC₅₀ value of

269.712 µg/ml and 434.02 µg/ml was recorded for *Polyalthia longifolia* leaf phenolic extract and Acarbose respectively.

Gas chromatography-Mass spectroscopy profile of *Polyalthia longifolia* leaf phenolic extract

Polyalthia longifolia was revealed to contain 31 compounds according to GCMS analysis. With 2,3-dihydro-2-Benzofuran, (34.33), 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-Pyran-4-one (10.40), Methoxyacetic acid, 2-propenyl ester (7.29) and 2-Pyridinecarboxaldehyde (5.72) being the five most empirically dominant since, put together, they account for more than 50% of all the peaks in the GCMS analysis of polyalthia longifolia leaf phenolic extract (Table 1; Figure 7).

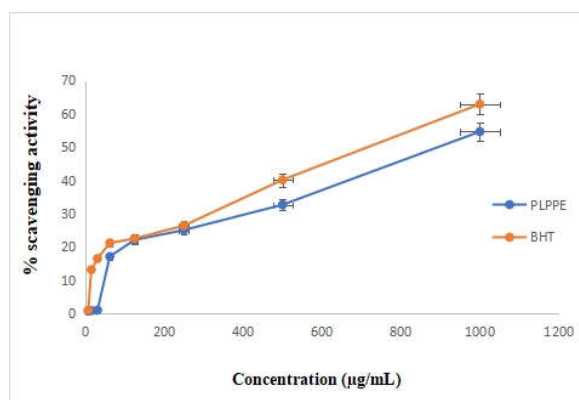


Figure 1: Nitric oxide scavenging potential of *Polyalthia longifolia* leaf phenolic extract

Values are mean ± standard deviation (SD) of triplicate determinations (IC₅₀: PLLPE = 850 µg/ml; BHT = 719 µg/ml).
PLLPE = *Polyalthia longifolia* leaf phenolic extract
BHT = Butyl Hydroxytoluene

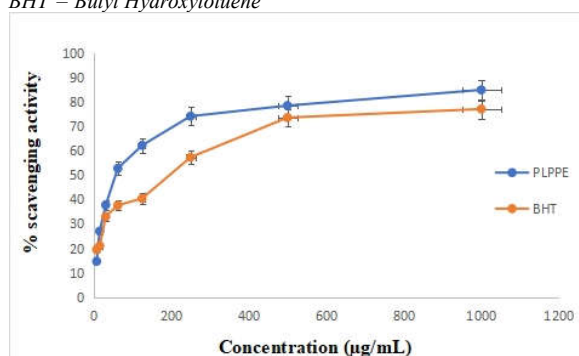


Figure 2: Hydroxyl scavenging potential of *Polyalthia longifolia* leaf phenolic extract

Values are mean ± standard deviation (SD) of triplicate determinations. (IC₅₀: PLLPE = 178 µg/ml; BHT = 337.40 µg/ml).

PLLPE= *Polyathia longifolia* leaf phenolic extract
BHT = Butyl Hydroxytoluene

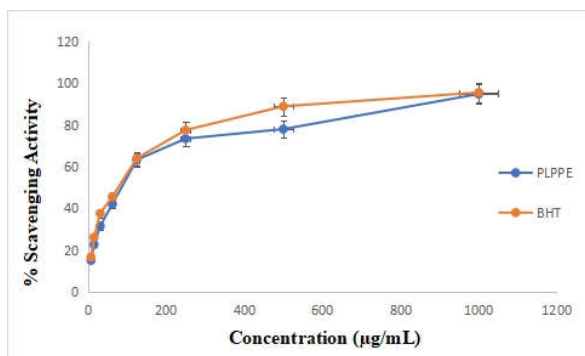


Figure 3: ABTS inhibition potential of *Polyathia longifolia* leaf phenolic extract

Values are mean $\pm$ standard deviation (SD) of triplicate determinations (IC_{50} : PLLPE = 212.2 μ g/ml; BHT = 157.23 μ g/ml).
PLLPE= *Polyathia longifolia* leaf phenolic extract
BHT = Butyl Hydroxytoluene

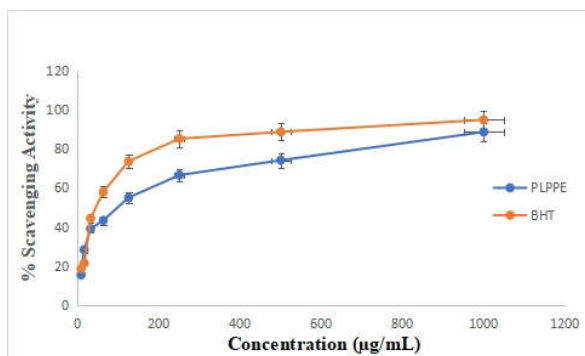


Figure 4: DPPH inhibition potential of *Polyathia longifolia* leaf phenolic extract

Values are mean $\pm$ standard deviation (SD) of triplicate determinations (IC_{50} : PLLPE = 227.47 μ g/ml; BHT = 85.90).
PLLPE= *Polyathia longifolia* leaf phenolic extract
BHT = Butyl Hydroxytoluene

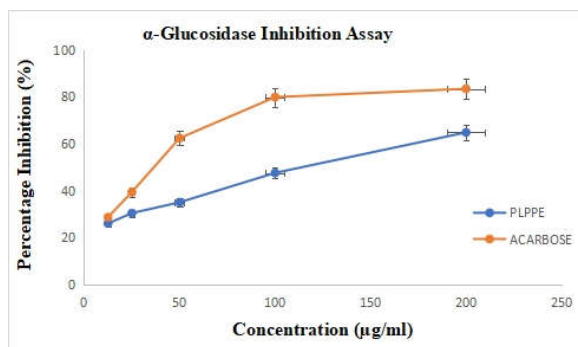


Figure 5: α -glucosidase Inhibition potential of *Polyathia longifolia* leaf phenolic extract

Values are mean $\pm$ standard deviation (SD) of triplicate determinations (IC_{50} : PLLPE = 122.64 μ g/ml; Acarbose = 45.60 μ g/ml).

PLLPE= *Polyathia longifolia* leaf phenolic extract

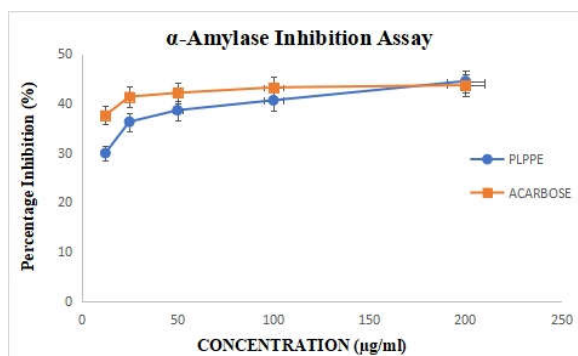


Figure 6: α -amylase inhibition potential of *Polyathia longifolia* leaf phenolic extract

Values are mean $\pm$ standard deviation (SD) of triplicate determinations (IC_{50} : PLLPE = 269.712 μ g/ml; Acarbose = 434.02 μ g/ml). PLLPE= *Polyathia longifolia* leaf phenolic extract

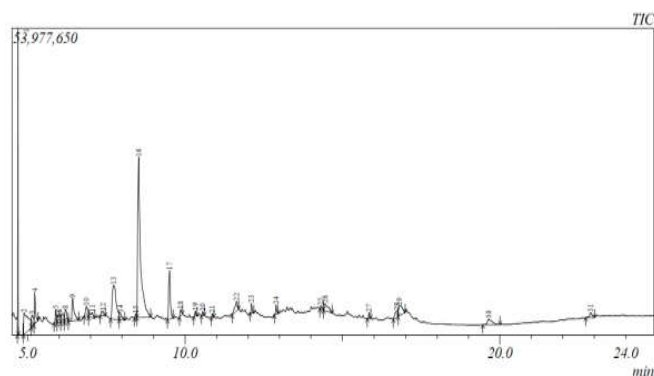


Figure 7: GCMS Chromatogram of *Polyathia longifolia* leaf phenolic extract

Table 1: GCMS Profile of *Polyalthia longifolia* leaf phenolic extract

Peak	Retention time (min)	Area percentage	Molecular weight (gmol ⁻¹)	Molecular formular	Name
1	4.692	5.72	107	C ₆ H ₅ NO	2-Pyridinecarboxaldehyde
2	4.883	7.29	130	C ₆ H ₁₀ O ₃	Methoxyacetic acid, 2-propenyl ester
3	5.143	1.57	98	C ₅ H ₆ O ₂	2-Furanmethanol
4	5.227	2.64	93	C ₆ H ₇ N	Pyridine, 3-methyl-
5	5.891	1.18	107	C ₇ H ₉ N	Pyridine, 3-ethyl-
6	6.008	1.57	144	C ₆ H ₈ O ₄	2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one
7	6.075	1.60	94	C ₆ H ₆ O	Phenol
8	6.202	1.96	129	C ₆ H ₁₁ NO ₂	2,4-Dimethyl-2-oxazoline-4-methanol
9	6.431	3.74	129	C ₆ H ₁₁ NO ₂	Pyrrolidin-1-acetic acid
10	6.867	1.81	128	C ₆ H ₈ O ₃	2,5-Dimethyl-4-hydroxy-3(2H)-furanone
11	7.058	1.28	124	C ₈ H ₁₂ O	Ethanone, 1-(1-cyclohexen-1-yl)-
12	7.392	0.72	126	C ₇ H ₁₄ N ₂	Octahydropyrrolo [1,2-a] pyrazine
13	7.731	10.40	144	C ₆ H ₈ O ₄	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-
14	7.950	1.17	122	C ₈ H ₁₀ O	Phenol, 4-ethyl-
15	8.433	0.50	135	C ₈ H ₉ NO	2-Pyridylacetone
16	8.529	34.33	120	C ₈ H ₈ O	Benzofuran, 2,3-dihydro-
17	9.508	6.40	150	C ₉ H ₁₀ O ₂	2-Methoxy-4-vinylphenol
18	9.860	0.66	154	C ₈ H ₁₀ O ₃	Phenol, 2,6-dimethoxy-
19	10.326	0.48	149	C ₈ H ₇ NO ₂	Benzonitrile, 4-hydroxy-3-methoxy-
20	10.562	0.30	151	C ₁₀ H ₁₇ N	Pyrrolidine, 1-(1-cyclohexen-1-yl)-
21	10.864	0.29	208	C ₁₂ H ₈ N ₄	Bicyclo[2.2.2]oct-5-ene-2,2,3,3-tetracarbonitrile
22	11.635	2.04	155	C ₈ H ₁₇ N ₃	1,3-Propanediamine, N'-(ethylcarbonimido)
23	12.109	0.77	180	C ₁₀ H ₁₂ O ₃	3',5'-Dimethoxyacetophenone
24	12.891	0.81	179	C ₁₁ H ₂₂ BN	Propylamine, N-[9-borabicyclo[3.3.1]non-9-yl]-
25	14.308	0.47	162	C ₁₂ H ₁₈	11-Methylene-tricyclo[4.3.1.1(2,5)]undecane
26	14.451	2.23	167	C ₁₁ H ₂₁ N	Piperidine, 1-cyclohexyl-
27	15.843	0.40	256	C ₁₆ H ₃₂ O ₂	n-Hexadecanoic acid
28	16.725	1.58	239	C ₁₆ H ₃₃ N	1-Methyl-2-butyl-5-heptylpyrrolidine
29	16.808	2.88	288	C ₁₈ H ₂₈ N ₂ O	Bupivacaine
30	19.646	2.07	220	C ₁₅ H ₂₄ O	Longifolenaldehyde
31	22.886	1.12	414	C ₂₉ H ₅₀ O	.gamma.-Sitosterol

Discussion

Generally, the moderation of blood glucose concentrations towards normal range is mainly based on the use of oral hypoglycaemic agents and insulin. Available treatment options to achieve glycemic control, especially after diet for diabetics, have limited efficacy and are associated with undesirable side effects. This has prompted

renewed interest in phytotherapy for better, effective, and more efficient management of diabetes mellitus. The observed elevation in blood glucose level in diabetics is primarily due to unregulated hydrolysis of carbohydrate by pancreatic α -amylase and the subsequent uptake of glucose by intestinal α -glucosidases (Gray, 1975; Boachie *et al.*, 2021). An effective approach to managing counter therapeutic

glucose upsurge, which has far-reaching acute consequences, is to inhibit intestinal activity of α -glucosidases and pancreatic α -amylase, which in turn controls postprandial plasma glucose levels and consequently alleviate potential chronic vascular complications (Krentz and Baile, 2005; Kwon *et al.*, 2008).

This study revealed a laudable inhibitory activity of *Polyalthia longifolia* leaf phenolic extract on α -amylase and α -glucosidase. Inhibition of these enzymes could potentially be employed as an effective approach to control postprandial hyperglycaemia in diabetic patients. Moreso, the fact that results from this study indicated that *Polyalthia longifolia* leaf phenolic extract had moderate inhibitory activity at IC_{50} 122.64 μ g/ml for α -glucosidase when compared with the acarbose also suggest that it can inhibit the activity of α -glucosidase without the gastrointestinal side effects associated with the clinical use of acarbose. This submission is consistent with the finding Kajaria *et al.* (2013) and Sabiu *et al.* (2016), where moderate α -amylase and α -glucosidase inhibitions were proposed as better therapeutic approach to delay availability of dietary carbohydrate substrate for glucose production in the gut.

The free radicals are highly unstable and attain stability by extracting electrons of other molecules. Further, the free radicals, due to their highly reactive nature, damage the transient chemical species. The increased risk of many chronic diseases in humans was associated with the elevated free radical level as a result of a failure in endogenous antioxidant defense mechanism or exposure to environmental oxidants or damage to cell structures (Lobo *et al.*, 2010). Therefore, chronic disease progression and risks associated with them can be avoided by supplementation with proven antioxidants or by increasing the antioxidant defense. The role of medicinal plants in decreasing free radical-caused tissue injury reveals their antioxidant activity (Sylvie *et al.*, 2014).

Oxidative free radicals have been implicated in the pathogenesis of diabetes mellitus. It is also believed that the metabolic disorders in diabetes mellitus may be due to enhanced cellular oxidative stress and reduced antioxidant potential

(Modak *et al.*, 2007). Results from this study revealed that *Polyalthia longifolia* leaf phenolic extract had good free radical scavenging activity comparable to the Butyl Hydroxytoluene (BHT). The standard curves of % inhibition and scavenging effects coupled with IC_{50} values of the extract revealed a decrease in the concentration of these species which may be due to the scavenging ability of *Polyalthia longifolia* leaf phenolic extract. Generally, the attributes exhibited *Polyalthia longifolia* leaf phenolic extract may be linked to phenolic compounds antioxidant activities (Gülçin *et al.*, 2007).

Phenolic hydroxyl groups are good hydrogen donors. Hydrogen-donating antioxidants can react with reactive oxygen and reactive nitrogen species (Valentão *et al.*, 2003) in a termination reaction, which breaks the cycle of generation of new radicals. Following interaction with the initial reactive species, a radical form of the antioxidant is produced, having a much greater chemical stability than the initial radical. Phenols are also believed to have inhibitory effect on carcinogenesis (Jing *et al.*, 2010).

Though, further studies are needed to ascertain the roles of the components of the PLLPE in its bioactive potentials, the empirical dominance of some of its components is foretelling. This is because apart from the fact that they account for more than 50% of the GCMS peak areas, each of these compounds have also been linked to the potentials possessed by the extract. 2,3-dihydro-2-Benzofuran, (34.33), 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-Pyran-4-one (10.40), Methoxyacetic acid, 2-propenyl ester (7.29) and 2-Pyridinecarboxaldehyde (5.72) revealed by GCMS in PLLPE in this study are reported to possess diverse biological activities including antioxidant and antidiabetic potentials (Čechovská *et al.*, 2011; Paudel *et al.*, 2018; Miao *et al.*, 2019). This suggests that the bioactive potentials demonstrated by the *Polyalthia longifolia* leaf phenolic extract in this research could be due to any of these components, alone or in interaction with any other constituents of the extract.

Conclusion

The alpha amylase and alpha glucosidase inhibitory potentials of *Polyalthia longifolia* leaf

phenolic extract is apparent from the results of this study and the benefit on postprandial hyperglycemia is evident from its mild inhibition of alpha glucosidase. Furthermore, the extract evidently possesses free radical scavenging potentials. Thus, the extract contains compounds that can be explored in the management of type 2 diabetes mellitus and its oxidative stress-dependent complications.

Conflict of Interest

Authors declare that, as regards the publication of this article, there are no conflict of interest.

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