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Alpha-Glucosidase Inhibitory Triterpene and Flavonoids Isoltaed from *Prosopis africana* (Fabaceae) Growing in Zangon Danborno Sabon-Gari Zaria Kaduna

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ABSTRACT

Powdered stem bark of *Prosopis africana* was extracted in ethanol and the crude ethanol extract was suspended in distilled water. The solution was partitioned sequentially in a separatory funnel with petroleum ether, chloroform and ethyl acetate hence yielding petroleum ether, chloroform, ethyl acetate and aqueous fractions respectively. The extract and fractions were evaluated for their antioxidant, and antidiabetic potentials. The EtOAc fraction displayed significant antioxidant (IC_{50} value of 87.06 ± 22.02 unit) and α-glucosidase (IC_{50} values 498.27 µg/ml) inhibition. The purification and isolation of the EtOAc fraction using column chromatography techniques lead to isolation of two compounds which were identified using (1D) (NMR) and mass spectrometry as friedelane and quercetin. The compounds were evaluated for α-glucosidase inhibition. The ccompounds showed a significant inhibitory activity against α-glucosidase with an IC_{50} value of 50.9 ± 0.57 µg/ml and 89.8 ± 1.9 µg/ml for friedelane and quercetin respectively. This study shows the effectiveness of *P.africana* stem bark extract in inhibiting α-glucosidase thereby indicating its potential as anti-hyperglycaemic agents. The obtained result supports the medicinal traditional use of this plant.

Keywords: Fabaceae; *Prosopis africana*, *Triterpene*, Flavonoids; DPPH, α-glucosidase.

INTRODUCTION

Prosopis africana, is a medicinal plant used traditionally for the treatment of various diseases', almost all its parts are used in herbal medicine. The stem bark when crushed to pulp is placed on wound surface for wound healing (Ezike., 2010). It is used for the treatment of headache, toothache, rheumatism, skin diseases, fever and eye washes (Orwa *et al* 2009). *P. africana* is also used to treat tooth decay, childhood diarrhoea and chronic wounds. The leaves and stem barks of the plant are the most commonly used part in treating bacterial infections while the roots are primarily used for other therapeutic purposes (Alimata *et al.,* 2020).

Previous phytochemical studies on *P. africana revealed* the presence of 7,3,4-trihydroxy-3-methoxyflavone (Elmezughi *et al*., 2013), β-sitosterol, Quercetin, β-sitosterol 3-O-β-D glucopyranoside (Oscar *et al.,* 2018). Furthermore, alkaloids as Prosopine and Prosaprin. The phytochemical studies also revealed the presence of Flavonoids such as prosaprine and 7,3',4'trihydroxy-3-methoxy flavanone (Abah, 2014) (Elmezughi *et al*., 2013), Friedelin (Abah *et al*., 2014), (2*E*, 6*E*) farnesylamine, myricetin-3-O-rhamnoside, bis(2-ethylhexyl) benzene-1,2-dicarboxylate, lupeol, *ß*-sitosterol , stigmasterol glycoside, a mixture of bis(2-ethylhexyl) benzene-1,2-dicarboxylate (3) and bis(2-ethylhexyl) benzene-1,4-dicarboxylate (Yanda *et al*., 2022). The isolated compounds have shown

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range of bioactivities such antimicrobial activity (Oscar *et al*., 2018, Elmezughi *et al*., 2013 and Yanda *et al*., 2022) antioxidants activity (Yanda *et al*., 2022) and cytotoxicity (BST) (Elmezughi *et al*., 2013).

The most active fraction 'ethyl acetate' obtained in this research, was investigated for its antidiabetic property. The result obtained guided the isolation and structural elucidation of two compounds; a terpenoids Friedeline (1) and flavonoid Quercetine (2) (Figure 12). Their structures were elucidated by spectroscopic data analysis which was compared with literature data. The isolated compounds were assayed for their α-glucosidase inhibition.

MATERIALS AND METHODS

Plant Collection and Identification

The stem bark of *P. africana was collected from* Zangon Danborno Sabon Gari Zaria, Kaduna State. Latitude: 11° 06'60.00" N Longitude: 7° 43'59.99" (8.567843°). The collected sample was identified and authenticated by herbarium curator in the Biological Science Department, Ahmadu Bello University, Zaria, Nigeria. The samples were washed in water to remove soil debris, cut into smaller pieces and air-dried. The dried samples were ground to powder (Thiantongin., 2014).

Isolation

The finely powdered air-dried stem bark powder of *P.africana* (1022g) was cold mercerized with 2.5 litres of ethanol. The extract was filtered through Whatman filter paper (No. 1) (Mudi *et. al.,*2010; Thiantongin.,2014) and concentrated using a rotary evaporator (Buchi Rotavapor II, Buchi, Germany) at 40°C (Saadullah, 2017). A 5 g of the residue was dissolved in water and partitioned sequentially with Pet-ether, $CHCl_3$ and EtOAc in the ratio of (2:1, v/v), each to give, Pet-ether, $CHCl_3$, EtOAc and aqueous fractions respectively. The EtOAc extract (30 g) was purified by silica gel column chromatography (CC) using Pet-ether -EtOAc- (9:1 to 1:9, v/v), EtOAc 100%, EtOAc -MeOH 95:5 to 50:50 and finally MeOH 100% as an eluent, to give 36 major fractions. Major fractions 18 and 25 were purified by recrystallisation using pet-ether.

Bioactivity Test

2,2-Diphenyl-1-picrylhydrazyl (DPPH) Radical scavenging activity

The determination of the antioxidant activity of the plant extract using DPPH, was determined according to the published procedure (Ionita., 2003; Mariko., *et al*., 2016). In this method 50µl of various concentrations 1000 µg/ml, 500 µg/ml, 250 µg/ml, 100 µg/ml, 50 µg/ml of each extract was added in to the plate well in triplicate, followed each by (195 µl) of DPPH solution (0.1 mM). Exactly 50 µl of ascorbic acid and 50 µl of DPPH in separate well as (positive control). Wells containing ethanol alone serve as blank, while wells containing only DPPH serve as control. All wells in triplicate.

Absorbance was read at 517 (Ionita., 2003; Mariko, *et al*., 2016). The average value of the absorbance from each triplicate are then used to calculate its DPPH free radical scavenging percentage, according to this formula:

The capability to scavenge the DPPH radicals was calculated using the following equation

DPPH free radical scavenging (%) = $\frac{(A0-A1)}{A0} X\ 100$ …….... (1)

A0 = absorbance of blank sample
A1= absorbance of sample

In order to obtain IC_{50}, a graph of inhibition rate against the sample concentration was plotted. (Jain *et al*., 2012).

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α-Glucosidase Inhibition Assay

The effect of the plant extracts on α-glucosidase was determined according to the method described by Kazeem *et al*., (2013) using α-glucosidase from *Saccharomyces cerevisiae* and p-nitropheynyl-α-D-glucopyranoside (pNPG) (3.0 mM) as substrate. In this method, 50 µL of various concentrations of the extract and its fractions (30, 60, 120 and 240 µg/ml) each was pre-incubated with 100 µL of α-glucosidase (1.0 U/ml) for 10 mins. Then 50 µL of 3.0 mM (pNPG) as a substrate dissolved in 20 mM phosphate buffer (pH6). The reaction mixture was incubated at 37 ºC for 20 mins and stopped by adding 2 ml of 0.1M Na_2CO_3. The experiments were carried out in three replicates.

The α-glucosidase activity was determined by measuring the yellow-colored para-nitrophenol released from pNPG at 405 nm. The results (% Inhibition) are expressed as percentage of the blank (control) as in Equation

.

$$\% \text{ Inhibition } = \frac{(\text{Ac} - \text{Ae})}{\text{Ac}} X\ 100 \ldots\ldots\ldots\ldots\ldots (1)$$

where Ac and Ae are the absorbance of the control and extract, respectively. The concentration of extract resulting in 50 % inhibition of enzyme activity (IC_{50}) was determined graphically using Microsoft Excel.

RESULTS AND DISCUSSION

In this study, the inhibitory effects of Prosopis *africana* stem back extracts against α-glucosidase key enzyme and its antioxidant effect using DPPH were evaluated. The *P. africana*, stem bark was extracted with ethanol, and partitioned in various solvents to obtain petroleum ether, chloroform, ethyl acetate and aqueous fractions. Both the crude ethanolic extract and its fractions were screened for antioxidant and α-glucosidase inhibitory activity.

A Friedelin (white solids) and Quercetin (yellow needle) molecular mases 426 App. 6. and 302 App. 11: were respectively isolated from the active fraction (ethyl acetate) column chromatography.

Antioxidant Property of the Crude Extract and its Fractions

The aqueous extract from the stem bark extracts of P. *africana* exhibited the highest antioxidant potential with IC_{50} value of 2.24 ± 1.59 g/ml, followed by the standard ascorbic acid (44.59 ± 9.15 g/ml) then the ethyl acetate with (87.06 ± 22.02 g/ml) Table1. The Chloroform fraction exhibited the least antioxidant potential with IC_{50} value of 253.32 ± 9.81 g/ml as shown in Table 1. Among the crude extracts/fractions tested in the six different concentrations used (10, 50, 100, 250, 500 and 1000 g/ml), the antioxidant activity increased with an increase in concentrations of the extracts.

The antioxidant assay of the extract and its solvent fractions was performed according to the (DPPH) method described by (Sabah *et al*., 2016). In this study, the aqueous fraction of *P. africana* afforded a higher IC_{50} values of 2.24 ± 1.59 µg/ml Table 1. The antioxidant properties of the ethanol and aqueous extracts of *P. africana,* were reported affording an IC_{50} of 0.5 ± 0. and 1.160 ± 0.056 mg/ml respectively (Théophile *et al.,2020*). The aqueous and ethyl acetate fractions afforded the highest antioxidant activity with IC_{50} value of 2.24 ± 1.59 µg/ml and 87.06 ± 22.02 µg/ml respectively Table 1.

The antioxidant property of the aqueous and ethyl acetate extracts in this study predicted

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their potential as target in antioxidant therapy for diabetes- induced oxidative stress.–

Table 1: Antioxidant effect of the *P. africana* extracts and fractions

Conc (µg/ml)	IC_{50} (µg/ml)
Chloroform	253.32± 9.81
Ethyl acetate	87.06 ± 22.02
Ethanol	116.15 ± 10.05
Aqueous	2.24 ± 1.59
Ascorbic acid	44.59 ± 9.15

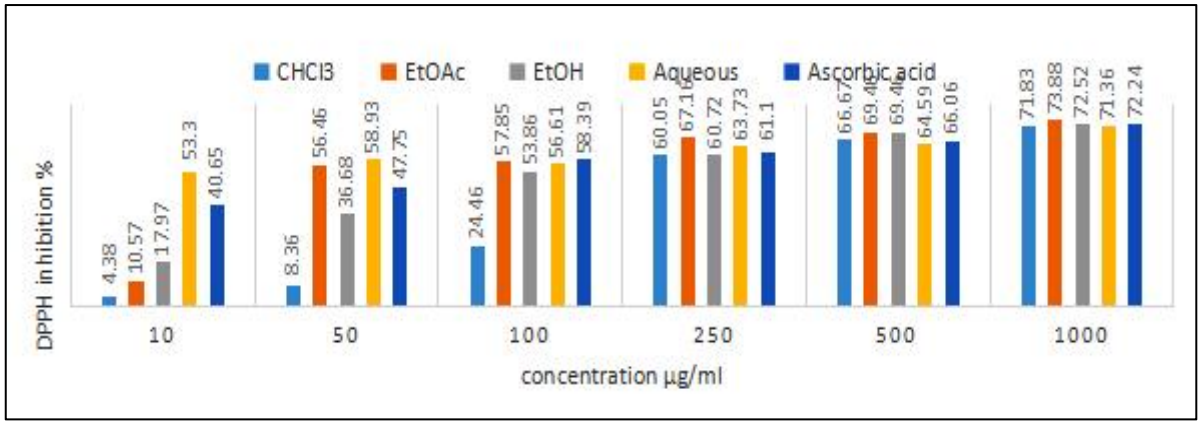

Figure 1: DPPH radical scavenging activity (%) of stem bark extracts of *P. africana*.

α-Glucosidase Inhibitory Property of the Crude Extract and its Fractions

A sustained hyperglycaemia condition greatly increased the generation of free radical, emanating from glucose auto-oxidation and other generation means; these exerts a modular effect on the oxidative stress level. The generated free radical can have a damaging effect to β-cells leading to the development of insulin resistance, a risk factor for diabetes type 2. Thus, antioxidant therapies to stop the diabetes-induced oxidative stress might be necessary in the therapeutic (Coulidiaty *et al*., 2021).

Inhibition of intestinal α-amylase and α-glucosidase is an important strategy to control post-prandial hyperglycaemia associated with type 2 diabetes mellitus. There is a growing interest among researchers to discover new and effective α-glucosidase inhibitors with minimal side effects from medicinal plants with known and scientifically proven antidiabetic properties (Mogale *et al*., 2011). This could be achieved by inhibiting the α-amylase and α-glucosidase key enzymes in carbohydrate digestion. Acarbose is an example of an α-glucosidase inhibitor currently in clinical use, but its prices are high and clinical side effects such as abdominal distention, flatulence, meteorism and diarrhoea are common (Nuno *et al*., 2013).

The α-glucosidase inhibitory activity of the extract obtained is expressed as IC_{50}. Lower IC_{50} values will signify lower concentration of the study plant extract or solvent fraction required to achieve 50% of α-glucosidase inhibition activity.

Table 2: α-Glucosidase Inhibitory Activity of the *P.africana* ethanol extract and fractions

Extract	IC_{50} (µg/ml)
Chloroform	296.23 ± 25.87
Ethyl acetate	498.27 ± 60
Ethanol	118 ± 2.83
Aqueous	56.27 ± 2.83
Acarbose	64.13 ± 2.52

α-Glucosidase Inhibition Activity

In order to examine the extract/fractions α-glucosidase inhibition, their activity was measured at different concentrations. Hence the percentage inhibitions were determined.

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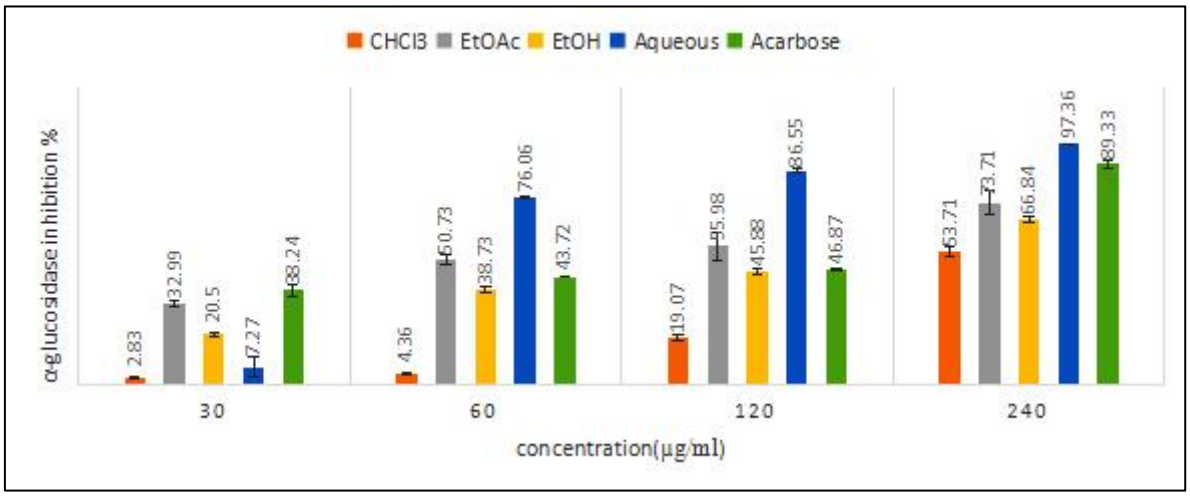

Figure 2: α-glucosidase inhibitory activity (%) of stem bark extracts of *P. africana*.

The *in vitro* α- glucosidase inhibitory activity of P. *africana* stem back extracts/fractions was investigated, the result is presented in Table 2. The results revealed P. *africana* stem back extract inhibited α- glucosidase in a dose-dependent manner (30 to 240 µg/ml) fig 2. However, aqueous fraction (56.27 µg/ml) had a significantly ($P > 0.05$) higher α-glucosidase inhibitory activity than other extracts/fractions in decreasing order of activity; 118, 296.23 and 498.27 µg/ml for ethanol, chloroform and ethyl acetate fractions respectively Table 2.

In the present study, *P. africana* ethanol extract and its fractions demonstrated a range of α-glucosidase inhibition. The aqueous fraction afforded the lowest IC_{50} value (56.27 ± 2.83 µg/ml) as compared to other fractions presented in an increasing order with 118 ±2.83, 296.33 ± 25.87 and 498.27 ± 60 µg/ml Table 2. for ethanol, chloroform and ethyl acetate respectively. This correlate well having the highest antioxidant property. The antioxidant property makes it protecting pancreatic β-cell from oxidative stress.

The extracts inhibited α-glucosidase in a concentration dependent manner Figure 2. Similar to the report by Coulidiaty *et al.,* 2021. However, at high concentration (120 and 240 µg/ml) the aqueous extract exhibited the highest inhibition 86.55 % and 97.36 %, respectively. This was also attested to by its α-glucosidase inhibition low IC_{50} value 56.27 ± 2.83 µg/ml Table 2. Both its ethyl acetate and chloroform fractions exhibited a good inhibitory activity against α-glucosidase with low inhibition as compared to ethanol and aqueous fraction. The α-glucosidase inhibitory activities of ethyl acetate fraction were approximately 9, 4 and 8-fold lower than aqueous, ethanol and acarbose, respectively producing a non-excessive inhibition of the enzymes Table 2. The sensitivity of the extracts is attributed to the polarity of the solvent fraction. A similar finding was reported for *P. ruscifolia* hydroalcoholic extract, which significantly decreased blood glucose in hyperglycaemic rats receiving the extract. (Sharifi-Rad *et al*., 2019).

Hypothetically, the polar phytocompounds from *P. africana* may possess anti-diabetic properties due to promising α-glucosidase inhibitory activity of the polar solvent Table 2.

The medicinal plants hyperglycemic agents should have a mild inhibition of α-glucosidase to preventing the side effects experienced with the use of synthetic drugs, (Kazeem 2013).

The range of α-glucosidase inhibition values from the findings of the present research,

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suggested the plant extracts and their fractions may possess potential α-glucosidase inhibitors. In a similar finding to the present research result, the aqueous and methanol extracts inhibited α-glucosidase activities in a concentration-dependent manner, producing comparable results with acarbose (Mousinho *et al.*, 2013). In vitro bioassay results of the α-glucosidase and α-amylase inhibitory activities of the plant acetone extracts demonstrated strong α-glucosidase inhibition at 97.4 ± 0.04% while acarbose demonstrated 80.6 ±0.03 % (Coulidiaty *et al.,* 2021).

Alpha-Glucosidase Inhibitory Activity of Isolated Compounds

The *in vitro* alpha-glucosidase inhibitory activity of friedelane and quercetin the isolates were evaluated. The compounds displayed significant alpha-glucosidase inhibitory activity with IC_{50} values of 50. 9 ± 0.56 µg/ml and 89.8 ± 1.9 µg/ml for friedelane and quercetin respectively Table 3.

Table 3: Alpha-glucosidase inhibitory activity of compound 1 and 2

Compound	IC_{50} (µg/ml)
Friedelane	50.9 ± 0.57
Quercetin	89.8 ± 1.9
Acarbose	64.13 ± 2.52

Spectroscopic Analysis

Spectroscopic Data of PA 18 from *P. africana*

PA 18 was isolated as white solid. m/z 426.3.0 (calculated for 426) for $C_{30}H_{50}O$ .IR V max: 3500-2500, 2921, 2851, 1722, 1462cm^{-1}; ^{1}HNMR and ^{13}CNMR: ($CDCl_3$,500MH_Z). Tables 4 shows the ^{1}H-NMR and ^{13}C- NMR Chemical shift of compound (PA18)

Table 4: ^{1}H-NMR and ^{13}C- NMR Chemical shift of compound (PA18)

Position	C(ppm) Experimental	H(ppm) Experimental	C(ppm) Literature	H (ppm) Literature
1	22.29	1.74	22.27	2.09, 1.61
2	41.55	2.24, 2.26	41.52	2.22, 2.33
3	213.3	-	213.37	-
4	58.25	2.26	58.20	2.24
5	42.16	-	42.15	-
6	41.31	1.58	41.26	1.65, 1.21
7	18.25	1.46	18.20	1.36, 1.46
8	53.12	1.37	53.07	1.37
9	37.45	-	37.42	-
10	59.49	1.51	59.44	1.50
11	35.64	1.28	35.60	1.26, 1.28
12	30.52	1.23	30.49	1.23, 1.26
13	39.72	-	39.68	-
14	38.31	-	38.27	-
15	32.44	1.48	32.39	1.38,1.48
16	36.03	1.46	35.98	1.35, 1,45
17	30.01	-	29.98	-
18	42.80	1.41	42.75	1.41
19	35.35	1.57	35.32	1.59, 1.19
20	28.19	-	28.16	-
21	32.78	1.45	32.74	1.42, 0.90
22	39.28	1.39	39.23	1.39, 0.91
23	6.83	0.87	6.82	0.82
24	14.66	0.73	14.64	0.70
25	17.95	0.80	17.94	0,79
26	20.27	0.98	20.25	0.98
27	18.68	0.94	18.66	0.94
28	32.10	1.17	32.07	1.15
29	35.03	0.93	35.60	0.93
30	31.79	0.88	31.77	0.88

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(Abah, et al, 2014)

DEPT of PA 18

18.4, 22.4, 28.3, 29.9, 30.2, 30.7, 32.6, 33.8, 35.5, ,35.8, 36.2, 39.4, 37.6, 38.5, 39.9, 41.5, 41.7, 7.0, 14.8, 18.1, 18.8, 20.4, 31.9, 32.3, 35.2, 43.0, 53.3, 58.4, 59.7.3.2.2 Figure 5.

Compound 1 was obtained as a white solid. Its molecular formula was deduced as $C_{30}H_{50}O$ at m/z 426.3 (calculated for 426) in Gas chromatography mass spectroscopy spectrum. The ^{1}HNMR spectrum of compound showed seven singlets at a characteristics range for methyl signals; at δ_H (ppm) 0.73 (H-24), 0.80 (H-25), 0.98 (H-26), 0.94 (H-27), 1.17(H-28), 0.93 (H-29) and 0.82 (H-30); the signal range at δ_H 2.24 to 2.26 were assigned to protons (H-2) of carbon adjacent to the carbonyl carbon Figure 3.

The ^{13}C-NMR spectrum of compound revealed a total of 30 carbon atoms, suggesting a triterpene skeleton Figure 4. Among the 30 carbons, a keto carbon signal was observed at δ 213.3 (C-3) which was highly deshielded, supporting the presence of protons at δ_H (ppm) 2.24 to 2.26 App. 4. The DEPT spectra of the compound revealed eight methyl, four methine and eleven methylene carbon groups App 5. Meanwhile, signals representing six quaternary carbon atoms were observed on the ^{13}C-NMR spectrum; δc 42.16 (C-5), 37.45 (C-9), 28.19 (C-20), 20.27 (C-26), 18.68 (C-27) and 32.10 (C-28) Figure 4.

The FT-IR spectrum of the compound Figure7. revealed a characteristics absorption band at 1737 cm^{-1} indicating the presence of a carbonyl group. This is in support of the keto carbonyl carbon signal observed at δ 213.3 (C-3) on the ^{13}C-NMR spectrum of the compound Figure4. The sp^3 C-H stretching absorption band at 2821 and 2921 was also observed on the FT-IR spectrum of the compound Figure 7. The mass spectrum of the compound showed molecular ion peak at *m/z* value 426, corresponding to the molecular formula $C_{30}H_{50}O$ App. 6. The spectroscopy data of compound was found to be consistent with literature data (Abah*, et al,* 2014) for friedelin. Therefore, compound was identified as friedelin.

Spectroscopic Data of PA25 from *P. africana*

PA 25 was obtained as yellow needle. MS m/z 302 (calculated for 302) for $C_{15}H_{10}O_7$. ^{1}HNMR (δ in ppm): (CD3OD,v600) and ^{13}CNMR(0δ): (CD3OD,v600)

Table 5: ^{1}H-NMR and ^{13}C- NMR Chemical shift of compound (PA25)

Position	C (ppm) Experimental	H (ppm) Experimental	C (ppm) Literature	H (ppm) Literature
1				
2	144.7		148.2	
3	135.7		137.2	
4	175.9		177.5	
5	162.1		162.6	
6	98.07	6.2	99.4	6.2
7	164.1		165.7	
8	93.26	6.4	94.6	6.34
9	156.7		158.4	
10	103.1		104.7	
1′	122.6		124.3	
2′	114.6	7.75	116.1	7.74
3′	146.8		146.3	
4′	147.3		150.3	
5′	115.0	6.9	116.1	6.9
6′	120.4	7.6	121.8	7.6

Mouffok *et al.,* (2012)

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Compound 2 was obtained as a yellow needle. Its molecular formula was deuced as $C_{15}H_{10}O_7$ at m/z 302 (calculated for 302). in high resolution electrospray ionization mass spectroscopy spectrum fig 11. The ^{1}HNMR spectrum of compound **2** revealed aromatic proton signals, at δ_H 6.2 and 6.4 that could be associated with benzo pyrone protons H-6 and H-8 respectively. A doublet signal at δ_H 7.6 and 7.7 was assigned to H-6' and H-2'. The hydroxyl protons at H-3, H-4', H-3, H-5' and H-7 are lumped together in a broad poorly developed signal near δ_H 12.3 ppm Figure 8.

The ^{13}CNMR spectra showed a characteristics signal at δ_H 175 ppm (C-4), for carbonyl carbon. Signals at δ_H 147 (C-2) and 156 (C-9) are within the ether carbon characteristic signal range. The signals range from δ_H 120 to 164 are characteristics range for aromatic carbons attached to OH group. Signals at δ_H 95 —115 are characteristics of aromatic carbon not attached to OH group Figure 9.

The FTIR spectrum of compound **2**, revealed a characteristic of hydroxyl and carbonyl functional group with peaks at 3500 and 1610 cm^{-1} respectively Figure10. Furthermore, Olefinic C-H stretching was observed at 2918 and 2851 cm^{-1}; aromatic C=C bond stretch appeared at 1428 cm^{-1} while C-O stretching peak was observed at 1158 cm^{-1} Figure 10. This IR data obtained supported the benzo pyrone moiety observed from the NMR data of compound **2**. The molecular formula of $C_{15}H_{10}O_7$ have an unsaturation value of 11, which is consistent with the molecular ion peak at *m/z* 302 from the mass spectrum of compound **2** App. 11.

From the spectral analysis of compound **2**, compared with literature data (Mouffok *et al.,* 2012), compound **2** was characterized as quercetin. Compounds **1 and 2** were evaluated for there α-glucosidase inhibition. Compound **1** showed stronger activity than the positive control, acarbose (IC_{50} 64.13 µg/ml) and compound two lower than acarbose.

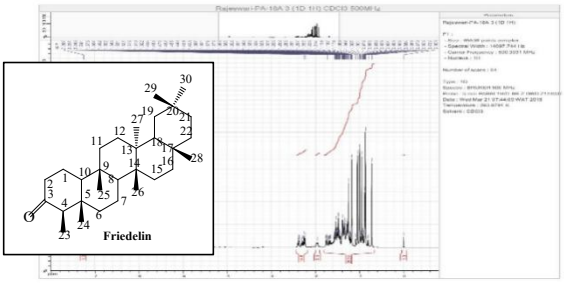

Figure 3: ^{1}HNMR spectrum for compound **(PA18)**

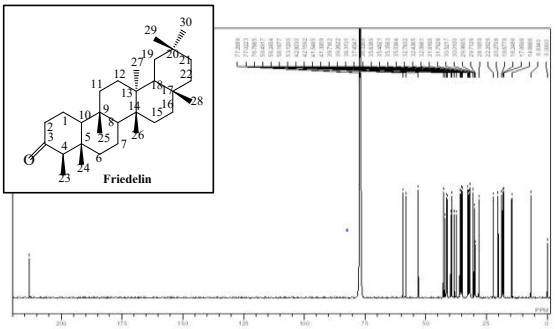

Figure 4:^{13}CNMR spectrum for compound **(PA18)**

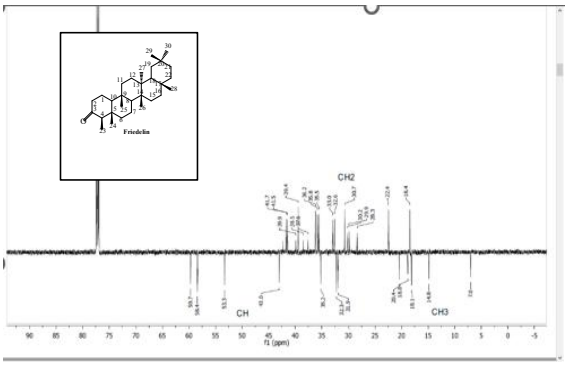

Figure 5: DEPT spectrum of PA18

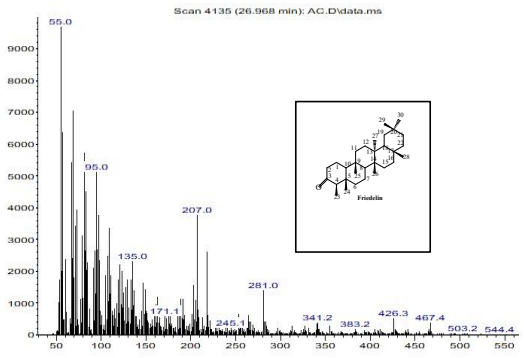

Figure 6: Mass spectrum for compound **(PA18)**

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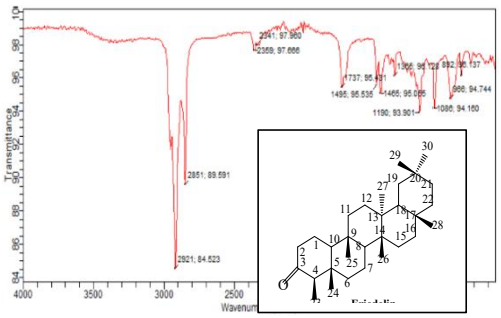

Figure 7: FTIR spectrum for compound **(PA18)**

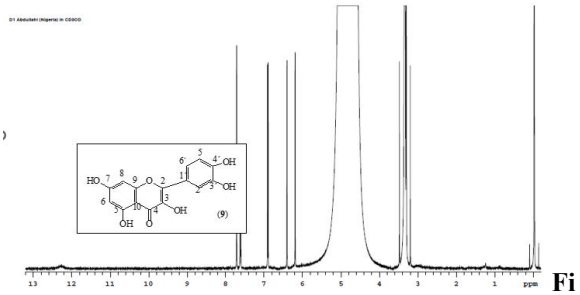

Figure 8: ^{1}HNMR Spectra compound **(PA25)**

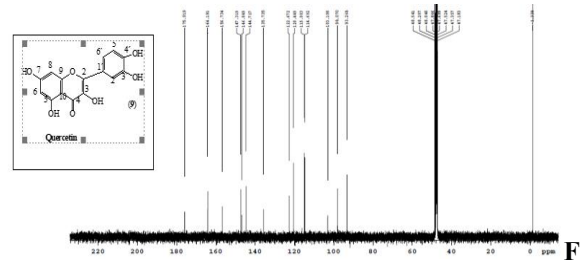

Figure 9: ^{12}CNMR Spectra compound **(PA25)**

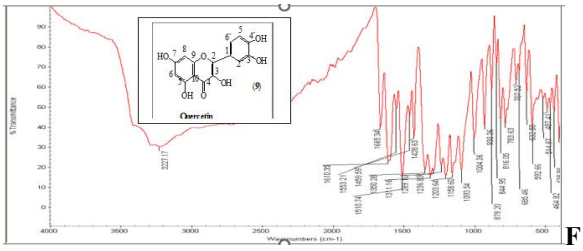

Figure 10: FTIR Spectra compound **(PA25)**

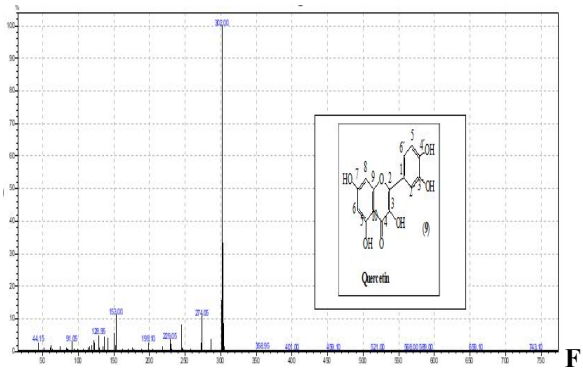

Figure 11: Mass Spectra compound **(PA25)**

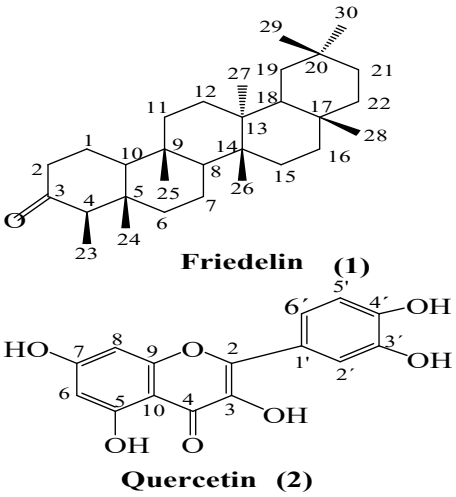

Figure 12: Chemical structures of compound 1 and 2

CONCLUSION

In the present study, two compounds were isolated from the ethyl acetate fraction. Compound 1 (friedelin) afforded significant α-glucosidase inhibition with IC_{50} value 50.9 ± 0.57 µg/ml, a higher inhibitory effect than the standard acarbose with IC_{50} value 64.13 ± 2.52 µg/ml. The finding of this study demonstrated that the ethyl acetate extract of *P. africana* contain potential α- glucosidase inhibitors. Overall, this study confirmed the anti- hyperglycemic potential of the study plant extracts and isolated compounds hence support the orthodox practitioners claimed for the study plant parts usage for the treatment of diabetes melletus.

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