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Phytochemical quantification, *in vitro* antioxidant and antidiabetic potentials of methanol and dichloromethane extracts of *Triclisia subcordata* (Oliv) leaves

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ABSTRACT

Triclisia subcordata (Oliv) is a useful medicinal plant for the treatments of several diseases in South West, Nigeria. The methanol and dichloromethane extracts from the plant were investigated for the presence of phytochemicals, antioxidants, inhibition of α-glucosidase and α-amylase activities. The determination of the antioxidant potential of the plant extracts was achieved through evaluation of 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay, nitric oxide scavenging activity (NOS), ferric reducing antioxidant potential (FRAP) and total phenolic content (TPC). The qualitative analysis results of the study indicated the presence of alkaloid, flavonoid, phenolics, tannin and saponin in *Triclisia subcordata* (Oliv) methanol extract (TRME), while only steroids, phenolics and flavonoids were detected in the *Triclisia subcordata* (Oliv) dichloromethane extract (TRDE). Methanol was seen to possess higher extraction capacity than dichloromethane. The quantitative determination of the extract showed that phenolics (593.7 ± 1.34) mg/100 g and flavonoids (192.6 ± 2.10) mg/100 g were more extractable in TRDE than TRME. The results showed that the plant extracts can be used to scavenge free radicals and hence, possess great antioxidant properties. It was also observed that the plant extracts possess a mild *in-vitro* α-glucosidase and α-amylase inhibiting activities. Thus, *Triclisia subcordata* (Oliv) may be used in the treatment and management of diabetes.

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1. Introduction

Plants are used as valued sources of food and medicine for the prevention of illness and maintenance of health of humans (Allam et al., 2018). The importance of medicinal plants has grown sporadically now that the world is turning to plants sources for drug supplements and herbal preparation for the management of human health. Moreover, due to consistent scientific verification of safety and efficacy, herbal products are more acceptable than ever before (Sarker and Nahar, 2018). Plants possess phytochemicals such as alkaloids, terpenoids, saponins, tannins, flavonoids, steroids, phenols, anthraquinones, aglycones, and glycosides etc. (Mahdavi, 2017; Mohammadhosseini et al., 2017; Mohammadhosseini, 2019). These plants also have various applications, especially in medicine, food, agriculture, cosmetic and chemical industries (Mohammadhosseini et al., 2017; Mohammadhosseini, 2017).

In medicine, the major importance of medicinal plants lies in their applicability as traditional medicine for treating and managing human diseases and ailments (Singh, 2015). Medicinal plants have found applications in treatments of several diseases and disorders which include rheumatism, muscle swelling, insect bites, pains, diabetes, oxidative stress, cancer etc. (Du et al., 2014; Mohammadhosseini et al., 2017; Mohadjerani and Asadollahi, 2019).

Ocimum gratissimum and *Vernonia amygdalina* possess common phytochemical compounds which are

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used in traditional medicine for the treatment of several ailments and the extracts have been evaluated for their ability to stall the activities of organisms responsible for spoilage of fresh catfish (*Clarias gariepinus*) by extending its shelf life (Oladosu-Ajayi et al., 2016). Lye derived from plant ash has found application in soap industry. Plants seed and leave oils are widely applied in perfumeries, paints, soaps and other cosmetic industries (Camilo et al., 2017; Mohammadhosseini, 2017).

Triclisia subcordata (Oliv) is a genus of flowering plant in the Menispermaceae family. It is a nature plant of west tropical Africa including Nigeria, Ghana, Ivory Coast, Sierra Leone, Senegal and Togo (Trease and Evans, 1993). The plant frequently serves as rope used for tying purposes; the importance of the species however rest with their medicinal application including the use of root extract for the treatment of snake bite, ulcer, diarrhea, malaria pyorrhea, swelling of extremities, anemia joint pains, cancer, rheumatic pains and hypertension in Nigeria (Dalziel, 1937; Irvine, 1961). The plant has also been evaluated for its antiulcer, antihistamine, antimicrobial, anticancer, antioxidant and antidiabetic activities (Asuzu and Anaga, 1995; Abo et al., 2011; Ayoola et al., 2016; Li, 2016; Uche et al., 2016; Uche et al., 2017).

In recent years, there has been an increase in the popularity and extensive usage of phytotherapy all over the globe (Sarker and Nahar, 2018). It is of great importance to ensure the efficacy of phytotherapy on the basis of suitable scientific evidence, and to put proper measures in place to regulate its practice as well as phytotherapeutic products (Sarker and Nahar, 2018). To the best of knowledge, this is the first report on the comparative analysis of quantification of phytochemicals, antioxidant, as well as inhibition of α-amylase and α-glucosidase enzymes *in vitro* report on *Triclisia subcordata* (Oliv) using both methanol and dichlromethane as extraction media. It is therefore important to investigate the biological roles of the plant in the organic media to further justify and validate its phytotherapeutic application in folk medicine.

2. Experimental

2.1. Sample collection

The leaves of *Triclisia subcordata* (Oliv) were collected from a farm at Ikere-Ekiti, Ekiti State, Nigeria. The plant was identified by the Herbarium curator at the Department of Plant Science and Biotechnology, Ekiti State University, Ado-Ekiti, Southwestern Nigeria, where a voucher specimen number UHAE 20191015 was assigned to the plant.

2.2. Sample preparation

The samples were washed and air-dried at room temperature for two weeks. The dried plant leaves were crushed using a mortar and pestle, then pulverized and homogenized into fine powder using an electric blender. The sample was thereafter weighed and stored in an air tight container pending analysis.

2.3. Extraction of plant material

The powdered plant material was extracted with methanol and dichloromethane (DCM). 25 g of the powdered plant material was soaked in 1000 mL of DCM for a period of 48 h. The extract was filtered and concentrated at 50 °C with the aid of rotary evaporator to give TRDE extract. The process was repeated using methanol as the extracting solvent to obtain the TRME extract. Both extracts were stored in an air tight sample vials pending analysis.

2.2. Qualitative analysis of phytochemicals

The presence of various phytochemicals like phenol, alkaloid, saponin, steroid, flavonoid, cyanogenic glycoside and terpenoid were detected using standard procedures (Trease and Evans, 1989; Sofowora, 1993; Tiwari et al., 2011).

Fig. 1. The photograph of *Triclisia subcordata* (Oliv) (www.waiwiki.org).

2.3. Quantitative phytochemical analysis

2.3.1. Determination of total phenol

This was determined using the Folin-Ciocalteu method (Singleton et al., 1999). Distilled water and Folin-Ciocalteu reagent were added to a 125 µL of each solvent extract. Each mixture was allowed to stand for 6 min before the addition of sodium carbonate solution (7.0% w/v). The mixture was allowed to stand for 90 min; absorbance was read at 760 nm on a SpectrumLab70 spectrophotometer and the result was expressed in terms of Gallic acid in mg/mL of extract.

2.3.2. Determination of saponin

The saponin content was determined using spectrophotometric method as described by (Brunner, 1984). 2.0 of each solvent extract was weighed into a beaker and isobutyl alcohol (but-2-ol) was added. Each mixture was filtered through No 1 Whatman filter paper into a beaker containing 40% magnesium carbonate ($MgCO_3$) solution. Approximately, 1 mL of the solution was transferred into volumetric flask. Then, 2 mL iron (III) chloride ($FeCl_3$) solution was added and made up the mark with distilled water. This was allowed to stand for 30 min for color development and absorbance was read at 380 nm on a SpectrumLab70 spectrophotometer.

2.3.3. Determination of tannin

The total tannin content was assessed by the standard protocol of Keerthana et al. (2013) with little modifications. The determination was carried out as follows. 0.5 mL of each solvent extract was diluted with 80% ethanol. From the diluted sample, 0.1 mL was added to 2 mL of FolinCiocalteu reagent. After 8 min, 7.5 mL of sodium carbonate (7%) solution was added and incubated for 2 hours. The absorbance was measured at 760 nm and the tannin content was estimated using tannic acid curve as the standard.

2.3.4. Determination of flavonoid

0.25 g of each solvent extract was dissolved in 1 mL distilled water. An aqueous solution of sodium nitrite ($NaNO_2$, 5%), 0.150 mL of freshly prepared aluminum chloride ($AlCl_3$) and NaOH (1.0 M) solutions were added. The mixture was allowed to stand for 5 min and absorbance measured at 510 nm on a SpectrumLab70 spectrophotometer. The result was expressed as quercetin equivalents (QE).

2.3.5. Determination of alkaloid

5.0 g portions of each solvent extract were first weighed into a beaker and 200 mL of 10% acetic acid in ethanol was added and allowed to stand for 4 min. The mixture was then filtered and each extract was concentrated on a water bath to one quarter of the original volume. Ammonium hydroxide solution was added in drops to the extract until the precipitation was completed. The precipitate was collected, washed with dilute ammonium hydroxide and filtered. The residue was dried and weighed (Harbone, 1973).

2.3.6. Determination of glycoside

2.0 g of the extract was extracted with 20 mL of ethanol (70%) and the mixture was filtered. 10 mL of the filtrate was transferred to 100 mL volumetric flask and the volume was filled up to the mark with distilled water. 10 mL of this mixture was further added to 10 mL of 12.5% lead acetate to precipitate resins, tannin and pigments. The mixture was vigorously shaken and filtered. 50 mL of the filtrate was pipetted into another 100 mL volumetric flask and 10 mL of 4.7% disodium hydrogen phosphate (Na_2HPO_4) solution was added in order to precipitate the excess lead. The mixture was made up to the volume with distilled water, mixed and filtered twice by the use of a filter paper. Baljet's reagent (10 mL) was then added to 10 mL of the purified filtrate. A blank sample of 10 mL of distilled water was added to Baljet's reagent and both solutions were allowed to stand for one hour which is required for color development. A blank of 20 mL of distilled water was used. The intensity of color was read at 495 nm with a spectrophotometer. The percentage of total glycosides was calculated with reference to the given standard curve (Mbahi et al., 2018). The percentage of glycoside was calculated using the equation below:

$$\text{Glycoside (\%)} = \frac{A}{17} \times 100 \quad \text{(Eqn. 1)}$$

Where A stands for the absorbance of the sample at 495 nm.

2.3.7. Determination of terpenoid

100mg (W_i) of each solvent extract was taken and soaked in 9 mL of ethanol for 24 hours. Each extract after filtration, was extracted with 10mL of petroleum ether using separating funnel. The ether extract was separated in pre-weighed glass vials and weighed (W_f) after it was completely dried (Indumathi et al., 2014). Ether was evaporated and the yield (%) of total terpenoids contents was calculated by the formula:

$$\text{Chelating(\%)} = \frac{W_i - W_f}{W_i} \times 100 \quad \text{(Eqn. 2)}$$

2.3.8. Free radical scavenging activities

2.3.8.1. Nitric oxide scavenging activity

2 mL of sodium nitropuside (10 mM) in 0.5 mL phosphate buffer saline (pH = 7.4) was mixed with 0.5 mL of each extract at various concentrations and the mixture incubated at 25 °C for 150 min, 0.5 mL was taken from the incubated mixture and added into 1.0 mL sulfanilic

acid reagent (33% in 20% glacial acetic acid) which was incubated at room temperature for 5 min. Lastly, 1.0 mL naphthyl ethylene diaminehydrochloride (0.1% w/v) was added and incubated at room temperature for 30 min. Then, the absorbance at 540 nm was measured with a spectro-photometer. The nitric oxide radicals scavenging activity was calculated (Garrat, 1964).

2.3.8.2. Determination of DPPH radicals scavenging activity

The free radical scavenging activity of the extracts was measured in terms of hydrogen donation or radical scavenging ability using the stable free radical DPPH (Fridovich, 1986). Determination of DPPH radicals scavenging activity was estimated with the method used by (Shirwaiker et al., 2006). Ethanol solution of DPPH (1 mM) and also 1 mg/1 mL extract solution in ethanol were prepared. 2 mL of the extract solution was added to 2 mL of DPPH. The absorbance was measured at 517 nm against the corresponding blank solution which was prepared from 3 mL ethanol and 3 mL of DPPH (control). The assay was performed in triplicates. Percentage inhibition of free radical DPPH was calculated according to the following equation.

$$\text{DPPH scavenged (\%)} = \frac{A_{con.} - A_{test}}{A_{con.}} \times 100 \quad \text{(Eqn. 3)}$$

2.8.3.3. Ferric reducing antioxidants potential (FRAP) assay

FRAP assay was performed according to the methods of Benzie and Strain (1999) with little modification. An amount of 0.5 mL extracted samples (1.0 mg/mL) were mixed with 3 mL FRAP reagent in test tubes and vortex mixed. Blank samples were prepared for both methanol and dichloromethane extracted samples. Both samples and blank were incubated in water bath for 30 minutes at 37 °C and the absorbance of the samples was determined against blank at 593 nm. Series of stock solution at 20, 40, 60, 80, and 100 µg/mL were prepared and using aqueous solution of $FeSO_4.7H_2O$ as standard curve.

2.9. α-Glucosidase inhibition activity

The inhibitory effect of each solvent extract on α-glucosidase activity was determined according to the chromogenic method described by Kim et al. (2005). 5 units of α-glucosidase were pre-incubated with 20 µg/mL of the different solvent extract for 15 min. Paranitrophenyl-glucopyranoside (PNPG) (3 mM) dissolved in 20 mM phosphate buffer, pH 6.9 was added to start the reaction. The reaction mixture was further incubated at 37 °C for 20 min and stopped by addition of 2 mL of Na_2CO_3 (0.1 M). The α-glucosidase activity was determined by measuring the yellow colored *p*-nitrophenol released from PNPG at 400 nm. Each test was performed in triplicates; the mean was used to calculate percentage α-glucosidase inhibition according to the following equation (Eqn. 4).

$$\alpha\text{-Glucosidase inhibition (\%)} = \frac{A_0 - A_1}{A_0} \times 100 \quad \text{(Eqn. 4)}$$

Where A_0 is the absorbance of the control (blank, without extract) and A_1 is the absorbance in the presence of the extract.

2.10. Inhibition of α-amylase activity

The inhibition of α-amylase activity was carried out using starch-iodine method. A total assay mixture comprising of 120 µL, 0.02 M sodium phosphate buffer (pH 6.9 containing 6 mM sodium chloride), 1.5 mL of salivary amylase and plant extracts of concentration range from 20-100 µg/mL were incubated at 37 oC for 10 min. Soluble starch (1.0%, w/v) was then added to each reaction mixture and incubated at 37 oC for 15 min. Subsequently, 1.0 M HCl (60 µL) was added to stop the enzymatic reaction, followed by the addition of 300 µL of iodine reagent consisting of I_2 (5 mM) and KI (5 mM). Color change was observed and the absorbance was recorded at 620 nm. Calculation was done according to equation below.

$$\alpha\text{-Amylase activity inhibition (\%)} = 1 - \left(\frac{A_0 - A_1}{A_0}\right) \times 100 \quad \text{(Eqn. 5)}$$

Where A_0 and A_1 respectively imply the absorbance of the control (blank, without extract) and absorbance in the presence of the extract (Xiao et al., 2006).

3. Results and Discussion

3.1. Qualitative analysis

The preliminary phytochemical analyses of the extracts of *Triclisia subcordata* (Oliv) includes the qualitative determination of saponin, alkaloid, steroid, tannin, phenolic, glycoside, terpenoid and flavonoid. Extraction with methanol and dichloromethane showed the presence of saponin, alkaloid, steroid, tannin, phenolic, and flavonoid. In the present study, only steroid, phenolic and flavonoid were found in TRDE while saponin, alkaloid, tannin, phenolic and flavonoid were detected in the TRME. This shows that methanol is a better solvent for extraction of the selected phytochemicals. The presence of these phytochemicals showed that the plant contain active antioxidants which could exert protective effects against major diseases such as cancer, inflammation, liver diseases, cardiovascular disease and act as a potential antiviral agent (Du et al., 2016; Dib et al., 2017). Similarly, the methanol extract of the root of *Triclisia. subcordata* (Oliv) had been reported to contain alkaloids, tannin and saponin (Abo et al., 2011). Several researchers in line with this study have shown the presence of bioactive phytochemicals in plants (Boukhanouf et al., 2016; Camilo et al., 2017).

Table 1
Phytochemical screening results of TRDE and TRME from *Triclisia subcordata* (Oliv).

Phytochemicals	TRME	TRDE
Saponins	+	-
Alkaloids	+	-
Steroids	-	+
Glycosides	-	-
Tannins	+	-
Phenolics	+	+
Terpenoids	-	-
Flavonoids	+	+

+: Present, -: Absent, TRDE: *Triclisia subcordata* (Oliv) dichloromethane extract, TRME: *Triclisia subcordata* (Oliv) methanol extract.

Steroid (present in TRME) is an important component of cell membrane that alters membrane fluidity and signaling molecule which activates steroid hormone receptors (Moss, 1989). Hence, *Triclisia subcordata* (Oliv) could also be relevant in treating certain inflammatory conditions, such as vasculitis (inflammation of blood vessels) and myositis (inflammation of muscle); it may also be used in the treatment of hypertension and abscession. The absence of terpenoid in both extracts showed that the plant lacks some essential aromatic qualities which could be essential for aromatherapy. Glycosides which could potentially be used as natural sweetener was not detected in both extracts. This may be due to the inability of both solvents used to extract glycosides or they are generally not present in the plant. The results of this study also showed that methanol better extracts more of the phytochemicals than DCM. This means that the TRME contains more phytochemicals than the TRDE.

3.2. Quantitative analysis

The amount in mg/100 mL of detected phytochemicals is presented in Table 2. It could be seen that the plant extracts contained high amount of phytochemicals. The terpenoids and glycosides were absent in both extracts.

Table 2
Quantitative phytochemical components of *Triclisia subcordata* (Oliv).

Type	Content (mg/100 mL) ± SD	
Phytochemicals	**TRME**	**TRDE**
Saponins	398.1 ± 4.0	-
Alkaloids	26.3 ± 0.03	-
Steroids	-	40.2 ± 0.02
Glycosides	-	-
Tannins	90.6 ± 5.4	-
Phenolics	310.9 ± 6.5	593.7 ± 1.34
Terpenoids	-	-
Flavonoids	176.0 ± 4.1	192.6 ± 2.1

Data were expressed as mean values ± SD

Saponin was the most abundant phytochemical of the TRME. It was detected only in the TRME with the value of 398.1 ± 4.0 mg/100 mL, while alkaloid was the least abundant phytochemical of the TRME with value of 26.3 ± 0.03 mg/100 mL. Phenolic, flavanoid and tannin also have high constituent values of 310.9 ± 6.5, 176.0 ± 4.1 and 90.6 ± 5.4 mg/100 mL respectively in the TRME. The TRDE contained higher quantities of the antioxidant compounds with phenolics having the highest value of 593.7 ± 1.34 mg/100 mL. The amount of flavonoid present was 192.6 ± 2.1 mg/100 mL while steroid had the value 40.2 ± 0.02 mg/100 mL. This is an indication that the TRDE could potentially exhibit better antioxidant properties than the TRME. The presence and relatively high constitutional values of these phytochemicals certified them for some major ethnomedicinal and ethnopharmacological uses**.**

3.3. Free radical scavenging activities

3.3.1. DPPH scavenging assay

Antioxidant properties of the TRME and TRDE were evaluated to find a new natural source of antioxidants. DPPH radical is a commonly used substrate for fast evaluation of antioxidant activity because of its stability and the simplicity of the assay (Bozin et al., 2008). This assay is known to give reliable information concerning the antioxidant ability of the tested compounds (Huang et al., 2005).

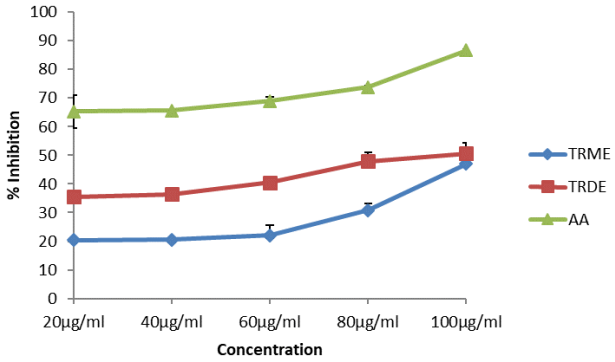

Fig. 2. DPPH scavenging activity of *Triclisia subcordata* (Oliv) extracts with ascorbic acid (AA) as standard.

The DPPH scavenging activity results of TRME and TRDE is shown in Fig. 2. The result showed a mild reducing power of the extracts. This suggests that the plant may be used as a free radical scavenger by reacting with radicals to convert them to a more stable product and terminate radical chain reaction. Moreover, the TRDE exhibited a significant dose dependent inhibition of DPPH activity with IC_{50} value of 97.2 µg/mL while that of ascorbic acid was 19.42 µg/mL. The IC_{50} value obtained for the TRME extract was 125.0 µg/mL. Basically, a higher DPPH radical-scavenging activity is associated with a lower IC_{50} value; thereby, the present study showed that the TRDE has a higher DPPH scavenging activity than the TRME and a lower activity than ascorbic acid. The

higher DPPH activity of TRDE may be attributed to its higher amount of phenolic, steroids and flavonoids as shown in Table 2. Also, with respect to the results, both extracts of the plant can be categorized as a moderate free radical scavenger. Thus, *Triclisia subcordata* (Oliv) contained antioxidants suitable to develop drugs for the prevention of human diseases related to oxidative stress. The results showed that plants contain active bioactive compounds capable of scavenging free radicals which is further supported by the study reported by Ayoola et al. (2017). Dhakal et al. (2016) also showed a mild DPPH scavenging activity for both methanol and chloroform extracts of *Azadirachta indica* plant.

3.3.2. Nitric oxide scavenging activities

Nitric oxide is a reactive nitrogen specie (RNS) that is produced by nitric oxide synthesis (NOS). The production of nitric oxide has been established as a mediator in various diseases including diabetes, renal ischemia, cancer, vascular and inflammatory diseases. The *in vitro* nitric oxide assay of *Triclisia subcordata* (Oliv) measures nitric oxides indirectly via the breakdown products of nitric oxides (nitrate and nitrite).

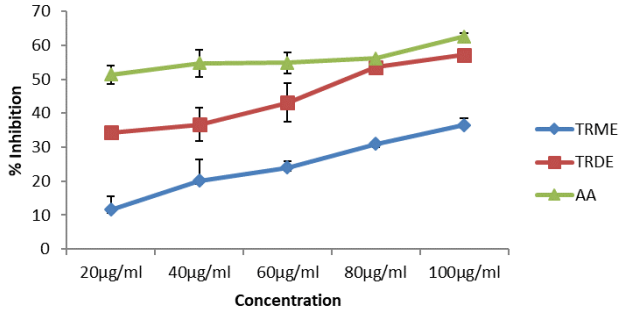

Fig. 3. Nitric oxide scavenging activities of TRDE and TRME extracts of *Triclisia subcordata* (Oliv) with ascorbic acid (AA) (standard).

The TRDE and TRME possessed mild antioxidant activity as shown in Fig. 3 when compared to the standard ascorbic acid (AA). TRDE at the concentration of 20 µg/mL-100 µg/mL showed nitric oxide inhibitory activity ranging from 34.36 to 57.22% with IC_{50} value of 76.0 µg/mL. TRME (20 µg/mL-100 µg/mL) exhibited potential nitrogen oxide inhibitory activity ranging from 11.64 to 36.58% with IC_{50} value greater than 100 µg/mL, while AA showed the highest inhibitory activity (51.40 to 62.54%) with IC_{50} value of 18.32 µg/mL. thus, the results showed that both extracts are potential nitric oxide scavengers. The results also showed that TRDE is a better nitric oxide scavenger.

3.3.3. Ferric reducing antioxidants potential (FRAP) assay

Antioxidative activity of a substance is also related to its reducing power. FRAP assay had been used to determine antioxidant activity because of its simple and quick advantage (Hodzic et al., 2009). More so, the reaction is reproducible and linearly related to molar concentration of the antioxidants. Higher FRAP values indicates higher antioxidant capacity as FRAP value is based on reducing ferric ion, where antioxidants are the reducing agent (Rabeta and Nur, 2013).

Table 3
Ferric reducing antioxidant potential (FRAP) assay of *Triclisia subcordata* (Oliv) extracts.

Extract	FRAP (mg/100 mL)
TRME	611.78 ± 7.58
TRDE	1431.76 ± 9.27

Data were expressed in mean values ± SD

The results (Table 3) showed that *Triclisia subcordata* (Oliv) possesses ferric reducing antioxidant potential. The FRAP values were higher in TRDE (1431.76 ± 9.27 mg/100 mL) compared to the TRME (611.78 ± 7.58 mg/100 mL). Thus, the TRDE exhibited a higher ferric reducing ability than the TRME.

3.3.4. Total phenolic content

Plant phenolic is one of the major groups of compounds that can act as primary antioxidants or free terminators (Dey et al., 2016). Phenols' ability to scavenge reactive oxygen species is usually as a result of their electron donating properties; hence, their antioxidant effectiveness depends on the stability in different systems, as well as number and location of hydroxyl groups (Podsedek, 2007). In this study, the total phenolic content for TRME and TRDE was calculated to be 318.75 ± 5.54 and 697.92 ± 2.05 mg/100 mL GAE respectively (Table 4) which showed that the DCM extract would potentially possess a higher antioxidant properties.

Table 4
Total phenolic content (mg/100 mL GAE).

Extract	Total phenolic content (mg/100 mL GAE)
TRME	318.75 ± 5.54
TRDE	697.92 ± 2.05

Data were expressed in mean values ± SD

3.4. Alpha amylase and alpha glucosidase inhibition activity

Acarbose (ACA), a commercially known α-glucosidase inhibitor showed strong inhibitory activity against α-glucosidase with IC_{50} value of 44.0 µg/mL. The IC_{50} values for α-glucosidase and α-amylase inhibitory activities of the TRME and TRDE were greater than 100 µg/mL.

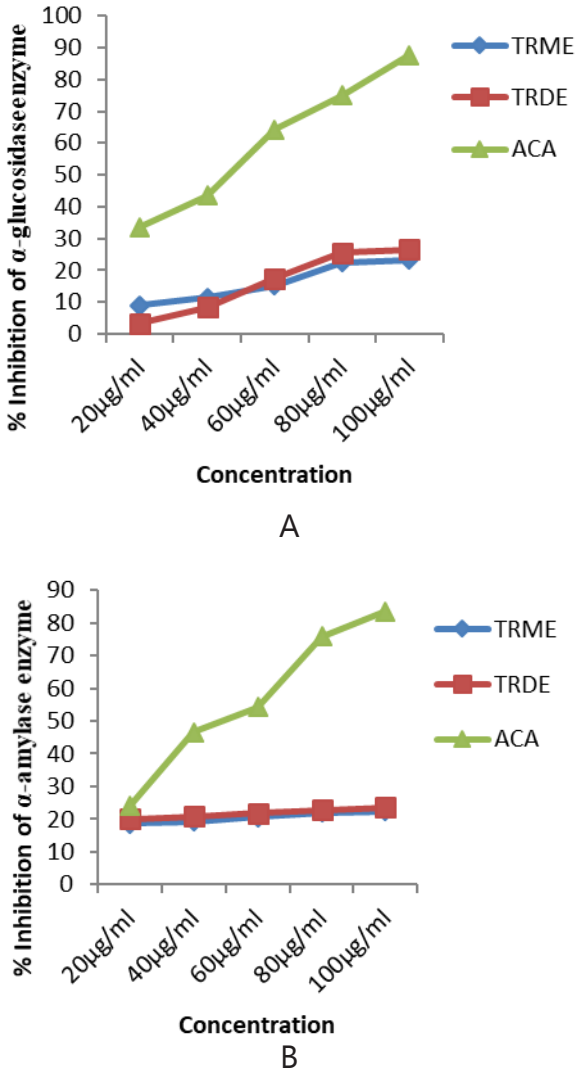

Fig 4. α-Glucosidase (A) and α-amylase (B) inhibition activity of *Triclisia subcordata* (Oliv) extract with acarbose (ACA) as standard.

The percentage for α-glucosidase and α-amylase inhibition of both extracts was low compared to acarbose (standard) as revealed in Fig. 4. This showed that the plant extracts have lower inhibitory potentials for the enzymes with calculated IC_{50} value > 100 µg/mL. The results also revealed that *Triclisia subcordata* (Oliv) is a potential α-glucosidase and α-amylase inhibitor.

4. Concluding remarks

The present study has evaluated the phytochemicals and biological roles of *Triclisia subcordata* (Oliv). The results showed that the plant exhibited high antioxidant activities and can be used as a free radical scavenger which implies that it can be used to treat oxidative stress and related diseases like inflammation, cancer and diabetes. Also, the findings from this research provide further insights on the biological roles of the plant as a potential inhibitor of enzymes such as alpha amylase and alpha glucosidase. The discoveries from this study further support the applications of the plant in folk medicine for acclaimed treatment of various ailments. Therefore, trends in production and commercialization of this plant and its medicinal products are encouraged for both ethnomedicinal and ethnopharmacological application. Further investigation of the fractions to isolate the bioactive constituents will be conducted as they may have potential use in medicine.

Conflict of interest

The authors declare that there is no conflict of interest.

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