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Comparison of phytochemical constituents of ethanol leaf extracts of *Solanum macrocarpon* and *Vernonia amygdalina*

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Abstract. *Oyesola OA, Sampson II, Augustine AA, Adejoke OB, Taiwo GE. 2022. Comparison of phytochemical constituents of ethanol leaf extracts of* Solanum macrocarpon *and* Vernonia amygdalina. *Asian J Trop Biotechnol 20: 6-10.* A plant can exert physiological changes on biological systems due to phytochemicals present in plant parts. This study evaluated and compared the phytochemical constituent (both quantitative and qualitative) and the antioxidant properties of the ethanol leaf extract *Solanum macrocarpon* L.and *Vernonia amygdalina* Delile using standard methods. Tannin, phenol, cardiac glycoside, alkaloid, and flavonoid were present in both plant extracts. In large quantities of alkaloid, flavonoid, and cardiac glycoside in *S. macrocarpon* compared to *V. amygdalina*. At the same time, *V. amygdalina* contained a large amount of tannin and phenol. Reducing sugar was present in *S. macrocarpon and* absent in *V. amygdalina*; saponin and steroid were present in *V. amygdalina* and absent in *S. marcrocarpon*; terpenoid and phlobatanin were both missing in the leaf extract of both plants. In contrast, both plant extracts showed radical scavenging activities, with *V. amygdalina* having a higher antioxidant capacity than *S. macrocarpon*. The present study's findings indicated that the ethanol leaf extract of *S. macrocarpon* and *V. amygdalina* possess antioxidant properties and may be effective against oxidative stress.

Keywords: Antioxidant, phytochemical, *S. macrocarpon, V. amygdalina*

INTRODUCTION

Plants' medicinal properties are attributed to synthetic components that have a distinct physiological effect on the human body; these compound substances are known as phytochemicals (Edeoga et al. 2005). Phytochemicals are currently receiving more attention because of their effectiveness in treating infectious diseases (Wamuyu et al., 2020). The phytochemical analysis of medicinal plants involves extracting, screening, and identifying bioactive compounds in different plant parts. Flavonoids, alkaloids, carotenoids, tannins, antioxidants, and phenolic compounds are some bioactive molecules obtained from plants. Phytochemicals are naturally found in plants and play an essential role in assisting plants to protect themselves against pathogenic microbes by demonstrating antimicrobial activity through hindrance or killing mechanisms. The discharge of these mixtures varies from one plant to the next, with some producing higher quality and others producing low quality (Tariq and Reyaz 2013). Research has found that phytochemicals present in fruits and vegetables decrease the risk of cancer, act as antioxidants, and may treat or manage infections and metabolic disorders (Abbasi et al., 2015). *Solanum macrocarpon* L.is the scientific name for the African eggplant, which belongs to the Solanaceae family and the plant genus Solanum (Agoreyo et al. 2012). Eggplants have a wide range of nutritional and therapeutic properties, making them a beneficial complement to any diet because they contain a significant amount of nutrients and phytochemical compounds such as saponins, phenols, flavonoids, and tannins, among others (Ibiam and Nwigwe 2013). Eggplant fruit aids in the prevention, management, and treatment of various diseases by lowering blood cholesterol levels, managing high blood pressure, reducing weight, and having anti-haemorrhoidal and anti-glaucoma properties (Ossamulu et al. 2014).

Because of its bitter taste, *Vernonia amygdalina* Delile is also called a bitter leaf. A small evergreen shrub grows throughout Africa and belongs to the Asteraceae family. It was reported to be a plant that can help with diabetes and fever management (Imaga and Bamigbetan 2013). The bitter taste of *V. amygdalina* is due to the presence of sesquiterpene lactones (vernodalin, vernolepin, and vernomygdin) and steroid glycosides (vernonisides) (Ojimelukwe and Amaechi 2019). Previous phytochemical studies on the leaf extract of *V. amygdalina* shows the presence of bioactive compounds like tannins, saponins, flavonoid, glycosides, alkaloids, and steroid. Traditionally, plants are also used to treat and manage malaria, intestinal parasite, diarrhea, and high blood sugar (Udochukwu et al., 2015). African eggplant and bitter leaf are important vegetables in African communities due to their nutritional and medicinal value; the study will compare and analyze the phytochemical constituent and in-vitro antioxidant properties of the ethanol leaf extract of *S. macrocarpon* and *V. amygdalina*; it will also add to the knowledge on their significance use in ethnomedicine.

MATERIALS AND METHODS

Plants material

Matured leaves of bitter leaf plants were collected from a family garden in the Sagamu local government area of South-West Nigeria. In contrast, matured leaves of African eggplant were bought from a local market in the Sagamu local government area of South-West Nigeria. In addition, authentications of the leaves sample were carried out at the department of plant science, faculty of science, Olabisi Onabanjo University, Nigeria.

Preparation of the ethanol leaves extract of African eggplant and bitter leaf plant

The leaves of African eggplant and bitter leaf plant were air-dried and powdered using a blender; 150 g of the blended leaves were soaked in 750 mL of ethanol (70% ethanol and 30% water) for three days and then filtered. After filtration, the filtrate was heated at a temperature of 40°C for evaporation.

Determination of percentage yield of African eggplant and bitter leaf plant

The percentage of African eggplant extract was determined by calculating the percentage of the weight of the extract to the original weight before drying the sample, using the formula;

$$percentage\ yield = \frac{weight\ of\ extract}{weight\ of\ sample} \times \frac{100}{1}$$

Weight of African eggplant= 150g
Weight of dried shaft of African eggplant= 73.4g
Weight of extract = 150g — 73.4g= 76.6g

$$P^{ercentage\ yield} = \frac{76.6g}{150g} \times \frac{100}{1} = 51.0\%$$

The percentage yield for African eggplant is 51.0%

The percentage yield for bitter leaf plant was also calculated using the same formula stated above;

$$percentage\ yield = \frac{weight\ of\ extract}{weight\ of\ sample} \times \frac{100}{1}$$

Weight of bitter leaf plant – 150g
Weight of dried shaft of bitter leaf plant- 70.10g
Weight of extract = 150g—70.10g= 79.9g

$$percentage\ yield = \frac{79.9g}{150g} \times \frac{100}{1} = 53.3\%$$

The percentage yield for bitter leaf is 53.3g

Phytochemical screening and in-vitro antioxidant procedure

Phytochemical tests were carried out on the ethanol leaf extract of *V. amygdalina* and *S.macrocarpon* using the standard procedure to identify the constituents present and in-vitro antioxidant enzymes activity as described by Harborne (1973), Trease and Evans (1989), Sofowra (1993), and Alisi and Onyeze (2008).

RESULTS AND DISCUSSION

Determination of the phytochemical present in the ethanol extract of the leaves extract of *Solanum macrocarpon* and *Vernonia amygdalina*

Tables 1 and 2 show the qualitative and quantitative (mg/100 g) analysis of the phytochemical constituents in the ethanol leaf extract of *S.macrocarpon* and *V. amygdalina*. The results revealed the presence of bioactive compounds in the extract studied from the table; the results show that phenols and tannins, flavonoids, and cardiac glycoside were present in both plant extracts. However, saponins were absent only in the ethanol extract of the African eggplant, and reducing sugar was absent in the ethanol extract of the bitter leaf plant. At the same time, steroids were missing in the ethanol extract of African eggplant. In addition, terpenoid and philobatanin were not present in both plant extracts. The results also show that the leaves of bitter leaf contained high levels of tannin and phenol compared to the leaves of African eggplant. In contrast, the leaves of African eggplant contain more alkaloids, cardiac glycoside, and flavonoids compared with the leaves of bitter leaf.

Plant phytochemical constituents are increasingly linked to the elicited physiological activities; in traditional medicine, plant parts are used to manage and treat various disorders (Gurib-Fakim 2006). The phytochemical screening results in Table 3 show the presence of active entities that elicit significant pharmacological and physiological responses. The presence of alkaloids, flavonoids, phenolic compounds, tannins, saponins, terpenoids, reducing sugar, steroid, and cardiac glycosides was observed. Tannins and flavonoids in the plant extract are responsible for the observed DPPH radical scavenging activity, as seen in Table 3. Flavonoids and tannins are phenolic compounds, which are the most abundant bioactive compounds in plants that act as antioxidants or free radical scavengers. The presence of one bioactive compound in the plant extract and its absence in another may be due to a difference in solvent polarity, which follows the rules of thumb" like dissolves like" (Adamu et al. 2019). The bitterness of African eggplants and bitter leaf plants is caused by the presence of alkaloids, primarily glycoalkaloids, and the degree of bitterness determines the edibility or otherwise. In general, ethanol extracts of bitter leaf plants contained more phytochemicals than ethanol extracts of African eggplant. The saponins found in the samples are major nutritional substances and nutraceuticals. Previous research studies have shown that medicinal plants' saponins reduce glycoside toxicity by hydrolyzing terpenoids (Xu et al. 1996; Chinedu et al. 2011). The antioxidant activity shown by the plant extracts in Tables 3-6 may result from the presence of phenolic compounds. The antioxidant action of phenolic compounds stems from their redox characteristics, which can aid the

absorption and neutralization of free radicals, singlet and triplet oxygen quenching, and the decomposition of peroxides (Al-Shaya et al., 2020). The food industry is increasingly interested in crude extracts of high phenolic medicinal plant materials (Osawa 1994).

Alkaloids are essential for plant protection and survival because they protect them from microorganisms' activities, insects and herbivores, and other plants (allelopathically active chemicals) (Molyneux et al. 1996). Plants containing alkaloids have been used as dyes, spices, drugs, and poisons almost since the beginning of human history. Cardiac glycosides are derived from steroids and act primarily on the cardiac muscle; they are potent in managing heart disease. Congestive heart failure causes an influx of Na^+ and an outflow of K^+ during each heart contraction. Na^+, K^+-ATPase must re-establish the concentration gradient before the next contraction by pumping Na+ into the cell against a concentration gradient. Cardiac glycosides inhibit Na^+ K^+-ATPase, increasing and increasing the force of myocardial contraction as a result (Farnsworth 1966); cardiac glycosides also have antitumor activity (Doskotch et al. 1972). Other studies have also reported the presence of a physiologically active substance in bitter leaf (Usunobun and Okolie 2015; Usunomena and Ngozi 2016) and African eggplant (Ilodibia et al. 2016; Eletta et al. 2017).

Table 1. Quantitative determination of phytochemical constituents of ethanol leaf extract African eggplant and bitter leaf plant

Sample	Tannin mg/100 g	Alkaloid mg/100 g	Reducing sugar mg/100 g	Cardiac glycoside mg/100 g	Phenol mg/100 g	Steroid mg/100 g	Flavanoid mg/100 g	Saponin mg/100 g
V. amygdalina	45.09	39.14	-	38.11	61.93	-	51.93	51.99
S. macrocarpon	39.80	69.61	45.90	38.30	41.21	31.25	67.51	-

Table 2. Qualitative determination of phytochemical constituents of ethanol leaf extracts African eggplant and bitter leaf plant

Sample	Tannin	Alkaloid	Reducing sugar	Cardiac glycoside	Terpenoid	Phenol	Phlobatanin	Steroid	Flavanoid	Saponin
V. amygdalina	+	+	-	+	-	+	-	+	+	+
S. macrocarpon	+	+	+	+	-	+	-	-	+	-

Note: + =present, - =absent

Table 3. DPPH radical scavenging activity of ethanol leaf extracts of *Solanum macrocarpon* and *Vernonia amygdalina*

Sample	25 µg/mL	50 µg/mL	75 µg/mL	100 µg/mL
V. amygdalina	31.25	47.06	59.44	77.72
S. macrocarpon	33.65	50.22	56.90	63.50

Table 4. Nitric oxide scavenging activity of ethanol leaf extracts *Solanum macrocarpon* and *Vernonia amygdalina*

Sample	25 µg/mL	50 µg/mL	75 µg/mL	100 µg/mL
V. amygdalina	37.88	48.07	61.29	77.27
S. macrocarpon	38.22	41.89	53.06	61.66

Table 5. Reducing power of ethanol leaf extracts *Solanum macrocarpon* and *Vernonia amygdalina*

Sample	25 µg/mL	50 µg/mL	75 µg/mL	100 µg/mL
V. amygdalina	0.12	0.26	0.32	0.46
S. macrocarpon	0.17	0.21	0.36	0.48

Table 6. Total flavonoid, total phenol, and total antioxidant activity of ethanol leaf extract *Solanum macrocarpon* and *Vernonia amygdalina*

Sample	Total flavonoid mg/100 g	Total phenol Mg/100 g	Total antioxidant capacity
V. amygdalina	51.92	61.93	52.07
S. macrocarpon	67.51	27.45	39.71

Evaluation of the antioxidant activity of ethanol leaves extract of *Solanum macrocarpon* and *Vernonia amygdalina*

Total Antioxidant Capability (TAC) was coined to describe the antioxidant's reducing capacity in a single metric. TAC of the ethanol extracts of was *S. macrocarpon* and *V. amygdalina* calculated using a variety of methodologies, including a DPPH radical scavenging activity assay and a nitric oxide scavenging activity, and a reducing power assay. In the DPPH radical scavenging activity assay, nitric oxide scavenging activity assay, and reducing power assay, absorbance directly represents reducing power (McCord 2000). Tables 3-6 show the ethanol extract's antioxidant activities in bitter leaf and African eggplant. The results of the DPPH scavenging activity of the extracts are shown in Table 4. The African eggplant and bitter leaf plant ethanol extract exhibited concentration-dependent antiradical activity by inhibiting DPPH radical with inhibitory concentrations of 63.50 at 100g/ml and 77.72 at 100 g/mL, respectively. Researchers commonly utilize the model system of DPPH radicals to explore the scavenging ability of various medicinal plant products (Benslama and Harrar 2016). Due to the hydrogen-donating ability of antioxidants, they can scavenge DPPH radicals (Baumann 1979). Free radicals scavengers are important to prevent the harmful effects of free radicals. The DPPH free radical scavenging methods are widely used to evaluate the antioxidant properties of plants extracts; the DPPH radical scavenging activity of *V. amygdalina* corresponds with the study of Erasto et al. (2007), Ho et al. (2012), Atangwho et al. (2013), while that of *S. macrocarpon* correspond with the study of Adewale et al. (2014) and Eletta et al. (2017). In the reducing power assay (Table 5), the presence of antioxidants in the samples would result in the extract donating an electron to reduce Fe^{3+} to Fe^{2+}. The extracts with reducing power reveal that they are electron donors, reduce oxidized intermediates, and act as primary antioxidants (Chanda and Dave 2009). The reducing power is frequently employed to access the antioxidant activity of natural plant products. The presence of reductants which act as an antioxidant by breaking free radical chains by donating a hydrogen atom, is often associated with the existence of reducing power (Rahman et al., 2015). Observation from Table 5 shows that the reducing power of both plant extracts was in different concentrations. These results also correspond with other studies which show that *S. macrocarpon* (Adewale et al. 2014; Famuwagun et al. 2017) and *V. amygdalina* (Ho et al. 2012; Adesanoye and Farombi 2014) have reduced power activity, but the ethanol leaf extract of *S. macrocarpon* had more reducing power when compared to the ethanol leaf extract of *V. amygdalina*. Nitric oxide (NO) or reactive nitrogen species such as NO_2, N_2O_4, N_3O_4, NO_3, and NO2 are formed during reactive nitrogen reactions with oxygen or superoxides. These compounds alter many cellular components' structural and functional behavior. Plant products can inhibit the detrimental consequences of excessive NO production in the human body, which could be of considerable interest in preventing the harmful effects of excessive NO production. NO has also been linked to inflammation, cancer, and other diseases (Moncada and Higgs 1993). Table 5 shows the relative NO scavenging potential of African eggplant and bitter leaf plant ethanol extracts. Since its identification as a new signal molecule, NO is linked to various physiological reactions. It produces vascular dilation by transmitting signals from vascular endothelial cells to vascular smooth muscle cells. It also plays an important part in respiratory, immunological, neuromuscular, and other physiological activities (Ebrahimzadeh et al., 2010). Other studies reported the NO scavenging activity of *S. macrocarpon* and *V. amygdalina* (Ng et al., 2015; Omede et al., 2018). Phenols are secondary metabolites found in plants. Most plant products can cause a pharmacological effect which includes; anti-inflammatory, antispasmodic, and anti-allergic, among others. Most pathological diseases and infections, such as diabetes, cancer, and cardiovascular disease resulting from oxidative injury, are caused by oxidative stress. The accumulation of reactive oxygen species (ROS) triggers a series of reactions that breaks down organic molecule such as DNA, lipids, and protein in the body, which are the main causes of disease (Halliwell et al. 1992; Craig 1999; Exarchou et al. 2002; Afanas'ev 2010). Many plant extracts that contain phenol compounds possess antimicrobial and antioxidant properties and are used to treat and manage disease (Choi et al., 2010). In Table 6, it was observed that the ethanol leaf extract of *V. amygdalina* has a high quantity of phenols compared with the ethanol leaf extract of *S. macrocarpon*. At the same time, total flavonoid content was high in the ethanol leaf extract of *S. macrocarpon* compared with *V. amygdalina*. The antioxidant activities of these plant extracts are due to the presence of flavonoid and phenol compounds.

In conclusion, the presence of tannins, alkaloids, cardiac glycoside, phenol, and flavanoid in the ethanol leaf extracts of *V. amygdalina* and *S. macrocarpon* are responsible for the physiological changes exerted by the plant on biological systems and also possess antioxidant properties and may be effective against oxidative stress caused by free radicals. However, more studies are needed to isolate the active ingredients in the combination of African eggplant and bitter leaf ethanol extracts and study their anti-inflammatory effect.

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