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Research paper

Phytochemical analysis, mineral composition and *in vitro* antioxidant activities of *Solanum macrocarpon* leaves

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Abstract

Background: The aim of this study is to determine phytochemicals and mineral composition as well as *in vitro* antioxidant activities of *Solanum macrocarpon* leaves.
Methods: Qualitative phytochemical screening was carried out using standard procedures while Mineral analysis was carried out using Atomic Absorption Spectrophotometer (AAS). *Solanum macrocarpon* leaves were also subjected for measurement of reducing power and antioxidant/radical scavenging activity (2,2-Diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity).
Results: Phytochemical screening revealed the presence of flavonoids, saponins, alkaloids etc. Mineral analysis showed calcium (256.60mg/100g) to be higher in concentration and copper (0.62mg/100g) least in concentration while manganese was absent. Other minerals includes magnesium (81.69mg/100g), potassium (87.22mg/100g), sodium (32.51mg/100g), iron (31.41mg/100g), zinc (1.41mg/100g). *Solanum macrocarpon* leaves showed maximum antioxidant activity (DPPH free radical scavenging and reducing power capacity) as the higher the concentration, the higher the antioxidant activity, thus the better the free radical scavenging potentials.
Conclusion: The data from this study revealed that *Solanum macrocarpon* has a rich content of phytochemicals, namely, saponins, alkaloids, flavonoids as well as minerals, bioactive components that are associated with health impacts. This study also revealed that *Solanum macrocarpon* leaves exhibit antioxidant activity. These findings thus suggest that *Solanum macrocarpon* leaves could act as potent source of antioxidants.

Keywords: *DPPH; Minerals; Phytochemicals; Reducing Power; Solanum Macrocarpon.*

1. Introduction

Solanum macrocarpon fruit specie of eggplant or garden egg is consumed throughout the African continent, served during ceremonies alongside with kola or sometimes in place of kola as well as being used in the preparation of delicacy including salad, stew and yam etc. Bukenya-Ziraba & Bonsu (2004) reported that the leaves have a variety of medicinal uses such as in Sierra Leone for the treatment of throat problems; in Kenya, for the treatment of stomach problems (Bukenya-Ziraba & Bonsu 2004). The fruit or the leafy part of the plant was reported to be used for the treatment of constipation, ulcers, tooth ache and the leaves as snake bite remedy (Oladiran 1989). The leafy part of *Solanum macrocarpon* was effective for treatment of skin disease, infections and sores when applied to the infected areas (Edijala et al. 2005). Generally, the plant has been used as indigenous medicine for the treatment of several ailments such as asthma, allergic rhinitis, nasal catarrh, skin infections, rheumatic disease and swollen joint pains, gastro-esophageal reflux disease, constipation, dyspepsia and also in weight reduction (Dalziel 1937). This study is aimed at assessing the phytochemicals and mineral elements as well as in vitro antioxidant activities of *Solanum macrocarpon* leaves.

2. Materials and methods

2.1. Collection, identification and preparation of plant materials

The fresh leaves were collected from a local farm in south eastern part of Nigeria. Identification and authentication were carried out after which the leaves were washed and air dried at room temperature for fourteen (14) days. They were grounded into fine powder using an electric blender and stored in a cool dry container until use for analysis.

2.2. Phytochemical analysis

Qualitative phytochemical screening using standard methods as described by Trease & Evans (1985), Harbone (1984), Sofowora (2008), Usunobun et al., (2015) and Usunobun & Okolie, (2015) were carried out.

2.3. Mineral analysis

Mineral analysis was carried out using Atomic Absorption Spectrophotometer (AAS) as previously done by Usunobun & Okolie, 2015a, b).

2.4. Determination of reducing power ability

The reducing power activity of *Solanum macrocarpon* leaves was carried out using the reducing power method. A mixture containing 2.5 ml of 0.2 M phosphate buffer (pH 6.6) and 2.5 ml of $K_3Fe(CN)_6$ (1% w/v) was added to 1.0 ml of stock *Solanum macrocarpon* leaf filtrate (0.2–1.0 mg/ml) prepared in distilled water. The resulting mixture was incubated for 20 min at 50°C, followed by the addition of 2.5 ml of TCA (10% w/v), followed by centrif-

ugation at 3000 rpm for 10 min. 2.5 ml of the supernatant was mixed with 2.5 ml of distilled water and 0.5 ml of $FeCl_3$ (0.1% w/v). The absorbance was measured at 700 nm against reagent blank sample. Increased absorbance of the reaction mixture indicates higher reducing power of *Solanum macrocarpon* leaves.

2.5. 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging ability

The DPPH method was used for the determination of DPPH free radical scavenging activity of the *Solanum macrocarpon* leaves as follows: DPPH (1 ml, 0.135 mM) prepared in methanol was mixed with 1.0 ml of stock *Solanum macrocarpon* leaf filtrate ranging in concentration from 0.2 to 1.0 mg/ml. The reaction mixture was then vortexed thoroughly and left in the dark at room temperature for 30 min. The absorbance was measured at 517 nm. The scavenging ability was calculated using the equation:

DPPH scavenging activity (%) = $[(Abs_{control} - Abs_{sample})]/ (Abs_{control})] \times 100$,

Where:

$Abs_{control}$ is the absorbance of DPPH + methanol and Abs_{sample} is the absorbance of DPPH radical + sample (sample or standard).

2.6. Statistical analysis

Data obtained from this study were expressed as mean value ± standard deviation.

3. Results

Phytochemical screening of *Solanum macrocarpon* leaves reveals it to contain flavonoids, saponins, alkaloids and phenols as shown in table 1

Table 1: Phytochemical Screening of *Solanum macrocarpon* leaves

Phytochemicals	Solanum macrocarpon
Flavonoids	Positive
Saponins	Positive
Alkaloids	Positive
Tannins	Negative
Phenols	Positive
Glycosides	Positive
Anthraquinones	Negative

The result of the minerals as shown in table 1 shows *Solanum macrocarpon* to be higher in calcium (256.60mg/100g) and least in copper (0.62mg/100g). Other minerals includes magnesium (81.69mg/100g), potassium (87.22mg/100g), sodium (32.51mg/100g), iron (31.41mg/100g), zinc (1.41mg/100g), while manganese was absent.

Table 2: Mineral Composition of *Solanum macrocarpon* leaves (mg/100g)

Minerals	*Solanum macrocarpon* (mg/100g)
Calcium	256.60 ± 4.34
Magnesium	81.69 ± 3.77
Potassium	87.22 ± 3.08
Sodium	32.51 ± 2.36
Phosphate	134.15 ± 4.15
Iron	31.41 ± 2.05
Zinc	1.41 ± 0.17
Copper	0.62 ± 0.08
Manganese	Absent
Chromium	0.75 ± 0.03

Values are means ± SD for 2 determinations.

Figure 1 shows the scavenging effect of *Solanum macrocarpon* on DPPH radical. The scavenging effect of *Solanum macrocarpon* produced a marked scavenging effect on DPPH radical in a dose dependent response with the highest percentage of 76.54% observed for the highest dose (1.0mg/ml). The reducing power of *Solanum macrocarpon* leaves as shown in figure 2 increased with an increase in concentration, thus dose dependent.

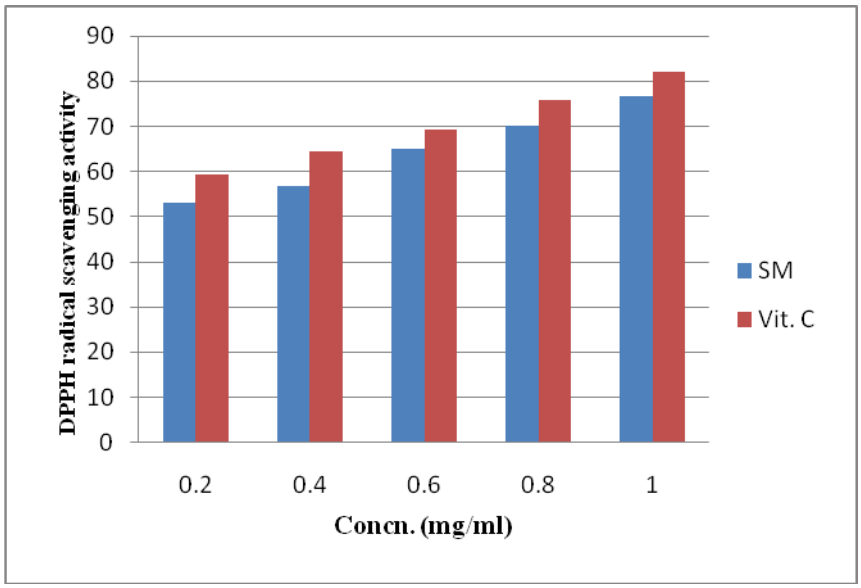

Fig. 1: DPPH radical scavenging activity of *Solanum macrocarpon* leaves

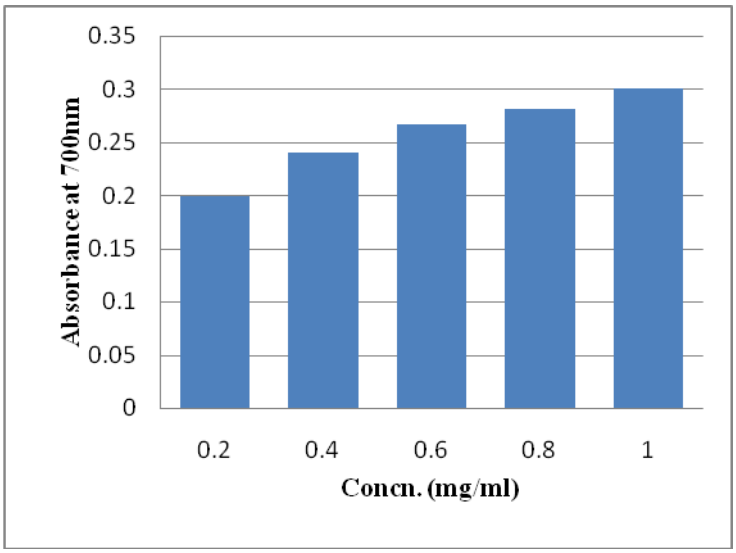

Fig. 2: Reducing power ability of *Solanum macrocarpon* leaves

4. Discussion

This work was a preliminary study and investigation of the active constituents in the leaves of *Solanum macrocarpon* showed the presence of alkaloids, flavonoids, saponins, tannin, resins and essential oil. The presence of these phytochemicals signifies the possession of medicinal properties within the leaves. Flavonoids possess antioxidant activity as well as anti-inflammatory and anti-viral infection activities etc. Flavonoids are free radical scavengers, super antioxidants and potent water soluble which prevent oxidative cell damage and have strong anticancer activity (Onwueyiagba 2001). Saponins have anti-carcinogenic properties and other health benefits. The presence of tannins shows that the leaves may have anti-fungal, anti-diarrheal and anti-plasmodial activity. Alkaloids have been used as Central Nervous Systsem (CNS) stimulant, topical anaesthetic in ophthalmogy, powerful pain relievers, antipuretic action, among other uses (Heikens et al. 1995).

Minerals are also co-enzymes in certain biochemical reactions in the body which underscores the importance of leafy vegetables in metabolic reactions (Mensah et al. 2008). *Solanum macrocarpon* was found to be composed of several minerals. This includes sodium, potassium, Calcium, phosphorous, iron, magnesium, copper, zinc, etc. Copper helps to produces red and white blood cells and triggers the release of iron to form haemoglobin, the substances that carry oxygen around the body. Zinc helps to form a large number of enzymes, many of which function in energy metabolism and in wound healing (Benowieez 1981). It also helps in DNA synthesis, storage, release, and function of insulin and also in the development of sexual organs and bones. Iron is essential for heamoglobin formation. Iron-deficiency anemia is characterized by poor oxygen-carrying capacity, a condition that causes endurance problems in athletes. Phosphorus is essential in bone and teeth formation, Manganese is a trace mineral involved in bone formation, immune function, antioxidant activity, and carbohydrate metabolism. Its deficiency may result in paralysis and convulsion (Benowieez 1981). It also activates enzymes involved in the transfer of phosphate and hydroxyl groups as well as some hydrogenation reactions.

Magnesium content of *Solanum macrocarpon* (81.69mg/100g) is low when compared to 961.9mg/100g of *Annona muricata* and 681.36mg/100g of *Vernonia amygdalina* (Usunobun & Okolie 2015a, b). Calcium content of *Solanum macrocarpon* (256.60mg/100g) is low when compared to 1118.30mg/100g of *Annona muricata* and 1264.18mg/100g of *Vernonia amygdalina* (Usunobun & Okolie 2015a, b). Calcium and phosphorous are associated with each other for growth and maintenance of bones, teeth and muscles (Okaka et al. 2006). Zinc content of *Solanum macrocarpon* (1.41mg/100g) compared favourably with 0.83mg/100g of *Annona muricata* and 1.42mg/100g of *Vernonia amygdalina* (Usunobun & Okolie 2015a, b). Sodium content of *Solanum macrocarpon* (32.51mg/100mg) is low compared to 69.49mg/100g of *Annona muricata* and 48.31mg/100g of *Vernonia amygdalina* reported by Usunobun & Okolie (2015a, b). Iron content of *Solanum macrocarpon* (31.41mg/100mg) compared favourably with 32.20mg/100g of *Vernonia amygdalina* but high when compared to 13.95mg/100g of *Annona muricata* as reported by Usunobun & Okolie (2015a, b). Potassium content of *Solanum macrocarpon* (87.22mg/100g) is high when compared to 36.31mg/100g of *Annona muricata* and 62.79mg/100g of *Vernonia amygdalina* (Usunobun & Okolie 2015a, b).

The reducing power assay is often used to evaluate the ability of an antioxidant to donate an electron. In this study, the presence of antioxidants in *Solanum macrocarpon* leaves caused the reduction of ferric cyanide complex (Fe^{3+}) to ferrous cyanide form (Fe^{2+}), changing the solution into various shades from green to blue, thus proving the reducing power ability of *Solanum macrocarpon* leaves. Hence, *Solanum macrocarpon* leaves may act as electron donors and could react with free radicals to convert them into more stable products and then terminate the free radical chain reactions.

DPPH (2, 2`-diphenyl-1-picrylhydrazyl) test provides information on the reactivity of test compounds with a stable free radical. In DPPH test, the degree of reduction in absorbance measurement as seen in this study is indicative of radical scavenging (antioxidant) power. Scavenging of DPPH radical in this study indicates the potency of *Solanum macrocarpon* leaves in donating hydrogen proton to the lone pair electron of the radicals. Because the inhibition was more at a higher concentration it could be suggested that *Solanum macrocarpon* leaves contain compounds capable of donating protons to the free radicals. In the present study, *Solanum macrocarpon* leaves exhibited comparable DPPH free radical scavenging ability in a concentration-dependent manner but not more than the standard ascorbic acid.

In conclusion, the presence of metabolites such as flavonoids, tannins, saponins etc in the leaves of *Solanum macrocarpon* are good indication that if the plant is subjected to further research and characterization, bioactive compounds with strong biological activities may be isolated and novel compounds may also be discovered. Also this study is quite promising as it clearly indicated that *Solanum macrocarpon* leaves possess powerful in vitro antioxidant activity which can be attributed to their phytochemical content.

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