# UNDERUTILIZED INDIGENOUS VEGETABLE (UIV) IN NIGERIA: A RICH SOURCE OF NUTRIENT AND ANTIOXIDANTS- A REVIEW

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***Abstract***
*Nigeria is endowed with varieties of indigenous vegetables which are not only known for their rich food nutrient content but also, as health promoting foods. Among which is Trichosanthes cucumerina, Solanum macrocarpon, Amaranthus virides, and Crassocephalum crepidoides. The purpose of this article is to review information available in scientific literature on the antioxidant, medicinal, pharmacological and biological activities of the plant. Searches were made and relevant information obtained from online resources such as Google search, Google Scholar, PubMed and Medline. Only literature highlighting the antioxidant, medicinal, pharmacological, biological and biochemical activities of the plant were selected for this review. There had been an increase interest in sources of natural antioxidants over the years as synthetic antioxidants such as Butylated Hydroxyl Anisole (BHA) and Butylated Hydroxyl Toluene (BHT) though effective in their operations as antioxidants possess side effects which are detrimental to human health. Plants have been established to be good source of natural antioxidants by previous studies. The antioxidant potential and nutritional values arising from the rich polyphenol content of these vegetables are discussed in this review. The vegetables discuss in this review can be said to be useful, inexpensive and readily available food resources, not just for it nutritional contents but as food which has the ability to prevent and control diseases arising from oxidative damages caused by free radicals and reactive oxygen species (ROS). Five vegetable species have been reviewed and this includes Trichosanthes cucumerina, Solanum macrocarpon, Amaranthus virides, and Crassocephalum crepidoides. The antioxidants and nutritional value of these vegetables is no longer in doubt. It is expected that this review will be useful to researchers, nutritionist, herbal medical practitioners and agriculturists, and would also encourage optimum exploitation of the plants for its several benefits .*

**Keywords:** camel *Trichosanthes cucumerina, Solanum macrocarpon, Amaranthus virides, Crassocephalum crepidoides,* antioxidants, free radicals, reactive oxygen species, indigenous vegetables

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## 1.INTRODUCTION

Nigeria is blessed with vast amount of vegetable which are not just consumed as food but also use for medicinal purposes. A number of indigenous vegetables in Nigeria have been identified and classified as underutilized by the Nigeria indigenous vegetable project (2015). They are inexpensive source of cheap and abundant source of proteins, carbohydrate, minerals, vitamins and fibres .Some of these vegetables includes; Glossy Night Shade *(Odu)*, Snake tomato *(Tomato elejo)*, Garden egg *(Igbagba)*, Amaranth *(Tete a tetedaye)* and Fire weed *(Ebolo)*. Though vegetables are known to be integral parts of various region of Nigeria, an insignificant proportion of our indigenous vegetable species are cultivated domestically while some are seen growing in the wild. Epidemiological studies had revealed that the consumption of vegetable and fruit can protect humans against oxidative damage. This damage has been associated with an increased risk of cardiovascular disease, cancer and other chronic disease (Boskou, 2006). Antioxidants prevent oxidative damage by inhibiting the action of free radicals and reactive oxygen species (ROS). Several evidence had showed that oxidative stress resulting from ROS including free radicals such as hydroxyl (OH-), superoxide (O-), nitric oxide (NO-), nitrogen dioxide (NO-2), peroxyl (ROO-) and non-free radical like hydrogen peroxide and singlet oxygen play an important role in the development of several pathological


 

conditions such as lipid peroxidation, protein oxidation, DNA damage and cellular degeneration (Hamzah *et al*.,2013). This had been implicated in the aetiology of these pathological conditions related to cardiovascular diseases, diabetes, inflammatory diseases, cancer, Alzheimer and Parkinson disease, monogolism, ageing process and perhaps dementia (Aruoma, 2003; Amin *et al.*,2004; Knekt *et al.*, 2004; Sahlin *et al.*, 2004) and consumption of dietary antioxidants from vegetables and fruits is beneficial in preventing these diseases (Sumazian *et al*, 2010; Faujam *et al*, 2009). Furthermore, high intake of food rich in natural antioxidants have been shown to increase the antioxidant capacity of the plasma and reduce risk of some, but not all of cancers, heart diseases and stroke (Kris-Etherton *et al.*, 2002).

Over 40 indigenous leafy vegetables are eaten in Nigeria, with the south-western part accounting for 24 of them (Adebooye *et al.*, 2003). Local vegetables are useful contributors to rural and urban people's diets in Nigeria (Barminas *et al.*, 1998). They play an important role in traditional-food culture and various ethnic groups consume varieties of different indigenous types of vegetables for different reasons (Mensah *et al.*, 2008). Approximately half of the leafy vegetables consumed in most Nigeria diets are from indigenous sources and they constituent significantly micronutrients (Lockett *et al.*, 2000; Grivetti and Ogle, 2000). Green leafy vegetables use for soup preparation cuts across different cultures within Nigeria and other parts of West Africa with similar cultural and socio economic background (Mensah *et al.*, 2008). It is well known that vegetables are rich in various antioxidants, including ascorbic acid, carotenoids, and phenolic and can be considered as source of natural antioxidant. Many plants including vegetables had been categorise as sources of natural antioxidants that can protect against oxidative stress and thus play an important role in the chemoprevention of diseases that have their aetiology and pathophysiology in reactive oxygen species (Dragland *et al.*, 2005; Odukoya *et al.*, 2001; Atawodi, 2005) . An alternative to antioxidant from plant is synthetic antioxidant such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT). However, there had been concerns about synthetic antioxidants because of their possible activity as promoters of carcinogenesis (Rahman *et al.*, 2008), prompting more interest in leafy vegetable which are source of natural antioxidant from Despite their nutritional and antioxidant content, just few scientific studies have been done to establish a seed germplasm for these vegetables and roles they could play in the formulation of healthy diet rich in natural antioxidants. Interesting, research have been intensify in recent years on not just the nutritional content of these underutilize vegetables, but their antioxidant properties. The purpose of this study is to review research findings and recommendation related to the antioxidant properties of these vegetables cultivated primarily in the southern part of Nigeria.

## 2. THE ANTIOXIDANT HYPOTHESIS

Oxidation is a very vital process for the generation of energy needed to fuel biological processes in the human body. This process usually results in the production of Reactive oxygen species (ROS) and free radicals that can lead to tissue damage and cell death if not control or curtail. The role of an antioxidant is to stop this from happening. Free radicals and ROS exert oxidative damage to body tissues and organs by reacting with molecules found in living cell including; proteins, nucleic acids, lipids and DNA. The effect of the action of ROS is usually the cause of a number of chronic and degenerative diseases which includes; cancer, atherosclerosis, ischemic heart disease, ageing, gastritis cancer, immunosuppression, neurodegenerative diseases and others (Narendra *et al.*, 2010; Raghavendra *et al.*, 2010).

Antioxidants are said to be substances which when present at low concentration are able to prevent or delay oxidative damage of lipids,

proteins and nucleic acids by these reactive oxygen species (Shehanaz, 2013).They can significantly delay or prevent the oxidation of easily oxidizable substances (Atrooz, 2009) and scavenge radicals by inhibiting initiation , breaking chain propagation or suppressing formation of free radicals. They do this by binding to the metal ions, reducing hydrogen peroxide, quenching superoxide and singlet oxygen. The antioxidant hypothesis says that 'as antioxidants can prevent oxidative damages, increased intakes from the diet rich in antioxidant will also reduce the risks of chronic diseases' (Stanner *et al.*, 2004). Plants have been found to be rich in polyphenols and flavonoids which might be connected with the high interest of researchers in exploring them. Compared to synthetic antioxidants which are detrimental to human health, vegetables have been found to be good source of natural antioxidants which are beneficial to human health without any corresponding side effect. Table 1 shows five vegetables found in Nigeria with their indigenous, English and Botanical name.

Table 1: Under-utilized Indigenous Vegetable

| Indigenous Name (Yoruba) | English Name | Botanical Name |
|---|---|---|
| Odu | Glossy Night Shade | *Solanum nigrum* |
| Tomati Elejo | Snake tomato | *Trichosanthes cucumerina* |
| Igbagba | Garden egg | *Solanum macrocarpon* |
| Tete a tetedaye | Amaranth | *Amaranthus virides* |
| Ebolo | Fire weed | *Crassocephalum crepidoides* |

Source: NIVP (2015)

## 3. ANTIOXIDANT OF SELECTED INDIGENOUS VEGETABLE

### 3.1. *Solanum nigrum*

*Solanum nigrum* is a short-lived perennial shrub that belongs to the *Solanaceae family*. It is popularly called Glossy Night Shade in English and *Odu* in Yoruba. The leaves of S. nigrum are alternate and sometimes ovate with characteristic irregular toothed wavy margin (Padmashree *et al.*, 2014). These plants produce small flowers that are about 4 to 10mm long with conspicuous yellow anthers and white petals that are arranged in a drooping umbel-like inflorescence (Njume *et al.*, 2014). These plants are used as vegetables in soup and as spinach in some parts of Nigeria. The berries are casually grown and eaten, but not cultivated for commercial use in India. In Ghana, the unripe green berries are called kwaansusuaa or abedru, and are used in preparing various soups and stews, including the popular palm nut soup commonly eaten with banku or fufu (Aseibe and Taiye, 1999). They are distributed in the southern part of Nigeria and are commonly found in forest or as weeds though cultivated as food crop on several continents, including Africa and North America. It contains polyphenolic compounds such as gallic acid, catechin, protocatechuic acid (PCA), caffeic acid, epicatechin, rutin, and naringenin (Sirtar and Dutta, 2008).

A previous study by Wannang *et al.* (2008) showed that methanol extract of S.nigrum had significant activity in various assays which includes 1, 1-diphenyl-2-picryl hydrazyl (DPPH) radical scavenging activity, estimation of the total phenolic compounds in the plant extracts, and determination of the 5-lipoxygenase activity. Methanol extract of S. nigrum had a 92 percent inhibition on DPPH; whereas, the aqueous extracts was observed to have considerably less effective radical scavenger activities. There was correlation between the antioxidant activity and polyphenols content which signifies that the phenolic compounds present in the plant contributes to the radical scavenging activity of the plant. Purified S. nigrum had also been reported to possess antioxidant activity. *S. nigrum* glycoprotein was shown to effectively inhibited hydroxyl radicals in a dose-dependent

manner. But the mechanism of scavenging action by stimulating cytokines (interleukin [IL] -2, IL-4, IL-12, IFN-γ, and tumor necrosis factor-alpha [TNF-α] remains to be explained (Lee& Lim, 2003; Ramya *et al.,* 2011). Padmashree *et al.* (2014) reported the antioxygenic activity of *Solanum nigrum L.* leaves. Various solvent extracts were evaluated using sunflower oil model system. Leaf powder and its methanol/water (80:20) soluble fraction was observed to showed strong antioxygenic activity in refined sunflower oil. On the other hand, ethyl acetate fraction exhibited marginal antioxygenic activity, whereas the water soluble fraction was observed to be practically devoid of any activity in refined sunflower oil. Thermal stability of different extracts of *Solanum nigrum L.* leaves heated at 80˚C in refined sunflower oil also indicated the strong efficacy of methanol/water (80:20) extract to inhibit thermal oxidation. Solanum nigrum L. reveal high levels of magnesium (239.0 mg/100g) and phosphorous (80.3 mg/100g). Fatty acid analysis of the lipid extracted from *Solanum nigrum L.* leaves indicated the presence of linoleic (59.1%) as a major fatty acid. The result of their study confirmed the presence of antioxygenic compounds in leaves. In particular, its methanol/water (80:20) extracts showed great potential as a natural antioxidant to inhibit lipid peroxidation in foods.

Aboul-Enein *et al.* (2014) reported the potent anticancer and antioxidant activities of active ingredients separated from *Solanum nigrum.* Eight active compounds were identified from crude extract of *S. nigrum* and each active compound was further evaluated for anticancer properties using Ehrlich ascites carcinoma cell (EACC) line and Hepatoma cell (HepG2) line. The antioxidant activity of each active compound was determined using the DPPH method. The identified compounds showed variable antioxidant activities and it was apparent from their study that effective drugs produced from *Solanum nigrum* tend to support the use of this plant in the treatment of cancer.

### 3.2. *Trichosanthes cucumerina*

*Trichosanthes cucumerina* is an important food and medicinal plant belonging to the family *Cucurbitaceae.* It is a tropical or subtropical vine raised for raised for its strikingly long fruit and used as a vegetable and for medicinal reasons by locals. It is commonly called as snake gourd, viper gourd, serpent gourd, chichinda, padwal, snake tomato, long tomato or *Tomato Elejo* (a native name by the Yoruba's in Nigeria). Flavonoids, carotenoids, phenolic acids are chemical constituents present in this plant which makes it pharmacologically and therapeutically active (Stephin and Grangaprasad, 2015). It is a monoecious annual vine with palmate lobed, up to 25cm long. Its fruit are long in shape protruding forward with a length of between 200-220 cm. it is usually deep red in colouration at maturity. Snake tomato fruit contains important nutrients such as carbohydrate, protein, vitamin A, vitamin C etc. necessary for good human and animal health (Ojiakor and Igwe, 2008).

Quite a number of researchers have observed free radical scavenging ability and antioxidant property in *Trichosanthes cucumerina.* Stephin and Gangaprasad (2015) studied the antioxidant activities of T. cucumerina. In their study, they investigated the antioxidant activity of different extracts, benzene, petroleum ether, chloroform, methanol and distilled water using the antioxidant scavenging effect on 2,2-diphenyl-1-picryhydrazyl radical (DPPH). Result obtained in their study reveals that alkaloids, flavonoids, phenols and tannins were present in high intensity in methanolic extracts. DPPH radical scavenging activity of extracts increased with increasing concentration while methanolic extract of whole plant showed significant antioxidant activity. The study concluded by establishing T. cucumerina as a source of phytochemical with significant presence of phenols, tannins, flavonoids, alkaloids and other active compounds which need to be investigated further. Adebooye *et al.* (2008) investigated the stress response of *Trichosanthes cucumerina L.* (Cucurbitaceae) to UV-B. UV-B radiation was observed to

affect the phytochemical composition of two variants of T. cucumerina L. by altering the contents of photosynthetic pigments, antioxidants (phenolic and ascorbic acid) and chlorophyll fluorescence. Antioxidants constituents comprising of phenolic and ascorbic acid composition was observed to decline at 4 hours exposure to UV-B. However, at 8 h after exposure, the total phenolic and ascorbic acid contents increased significantly compared to 4 h after exposure.

The antioxidant properties and inhibition of key enzymes linked to type-2 diabetes by snake tomato (*Trichosanthes cucumerina*) and two tomato (*Lycopersicon esculentum*) varieties were studied by Ademosun *et al.* (2013). Their study sought to compare the antioxidant properties of 1,1-diphenyl–2 picrylhydrazyl (DPPH) , hydroxyl (OH) radicals scavenging abilities and inhibition of $Fe^{2+}$-induced lipid peroxidation by two key enzymes relevant to type-2 diabetes (α-amylase and α-glucosidase) of snake tomato (*Trichosanthes cucumerina*) with two tomato varieties [Lycopersicon esculentum Mill. var. *esculentum* (ESC) and Lycopersicon esculentum Mill. var. *cerasiforme* (CER)]. Snake tomato (0.84 mg/g) and CER (0.87 mg/g) were observed to have significantly ($P < 0.05$) higher total phenolic content than ESC (0.27 mg/g). However, CER had the highest total flavonoid content of 0.48 mg/g, compared to snake tomato (0.27 mg/g) and ESC (0.15 mg/g). In consonance with the phenolic content, CER and snake tomato had higher DPPH and OH radicals scavenging abilities than ESC. Their result showed that snake tomato antioxidant properties compared favourably well with other cultivars of tomatoes and can be said to be rich in antioxidant.

### 3.3 *Amaranth viridus*

Amaranth is a widespread weed occasionally cultivated in Nigeria, Gabon and DR Congo (Adetutu *et al.,* 2013) and called *Tete a tetedaye* by the Yoruba natives in Nigeria. It is known as *Cheng-kruk* in Southern Indian and *callaloo* by the Jamaicans. Amaranths are cultivated like vegetables for their nutritive purposes and at other times, like decorative plants. They are erect or ascending annual or short-lived perennial herb that can grow up to 1m; glabrous, angular, bear branches, stem slender to sparsely pubescent in upper part with multicellular hairs (Md.Reyad-ul-Ferdous *et al.,* 2015). It also consists of alternate leaves with petiole which can be up to 10 cm long; blade deltoid-ovate to rhomboid-oblong ,flowers that are subsessile , green in colour and unisexual. Amaranth had been reported to contain thirty percent more protein than cereals such as rice, sorghum and rye (De Macvean and Poll, 1997). They are also good source of thiamine, niacin, riboflavin, folate, and dietary minerals which includes calcium, iron, magnesium, phosphorus, zinc and manganese that are comparable to grain products such as wheat germ, oats, and others (USDA, 2014). Extracts of A. viridus exhibited inhibitory effects *against Pseudomonas aeruginosa, Bacillus cereus, Enterobacter cloacae, Bacillus subtilis and Staphylococcus aureus* (Adetutu *et al.,* 2013) Regular consumption of amaranth oil had been reported to reduces blood pressure and cholesterol levels while improving the antioxidant status also (Martirosyan *et al.,* 2007). In Côte d'Ivoire, the leaf sap is used to treat eye infections, convulsions and epilepsy in children (Adetutu *et al.,* 2013).

Quite a number of researchers have observed free radical scavenging ability and antioxidant property in *Amaranth viridus.* Fresh leafy extract of A.viridus have been found to possess high antioxidant activity. Inglet *et al.* (2015) estimate the antioxidant activities of extracts of amaranth grain using three different solvent (water, 50% Ethanol and 100% Ethanol). It was suggested that their antioxidant properties can make them useful as a dietary antioxidant in food (Sravanthi and Rao, 2015). Table 3 reveals the free bound and total antioxidant activities of Amaranth grain products in aqueous extracts using water, 50% ethanol and 100% ethanol while Table 4 shows the free, bound and total phenolic contents of ancient grain products in aqueous extracts using water, 50% ethanol, and 100% ethanol.

Table 3. Free bound and total antioxidant activities of Amaranth grain products in aqueous extracts using water, 50% ethanol and 100% ethanol.

| Product | Ethanol (%) | Free µmol/g | % of total | Bound µmol/g | % of total | Total µmol/g |
|---|---|---|---|---|---|---|
| Amaranth | 0 | 0.97 ± 0.04 | 8.90 | 9.92 ± 0.04 | 91.01 | 10.90 ± 0.04 |
| Amaranth | 50 | 0.58 ± 0.02 | 5.54 | 9.88 ± 0.02 | 94.46 | 10.46 ± 0.04 |
| Amaranth | 100 | 0.13 ± 0.02 | 1.30 | 9.90 ± 0.02 | 98.70 | 10.03 ± 0.03 |

Source: Inglet *et al.*, (2015)

Table 4. Free, bound and total phenolic contents of ancient grain products in aqueous extracts using water, 50% ethanol, and 100% ethanol.

| Product | Ethanol (%) | Free µmol/g | % of total | Bound µmol/g | % of total | Total µmol/g |
|---|---|---|---|---|---|---|
| Amaranth | 0 | 1.76 ± 0.09 | 38.10 | 2.86 ± 0.22 | 61.90 | 4.62 ± 0.03 |
| Amaranth | 50 | 0.60 ± 0.01 | 14.22 | 3.62 ± 0.13 | 85.78 | 4.22 ± 0.14 |
| Amaranth | 100 | 0.53 ± 0.01 | 11.91 | 3.92 ± 0.13 | 88.09 | 4.45 ± 0.14 |

Source: Inglet *et al.*, (2015)

Enzymatic antioxidants such as Catalase, Peroxidase, Polyphenol Oxidase, Glutathione Reductase and non-enzymatic antioxidants such as Total Phenols, Vitamin C, Total Carotenoids, and Flavonoids were assessed in their study. The ability of A. viridis to scavenge free radicals and reactive oxygen species molecules has been attributed to their ability to overcome diseases such as stress, blindness, anaemia and age related diseases. This result was in agreement with the report of Saud *et al.* (2013) on the seed and leaf extracts of A. viridis. Appreciable levels of total phenolic contents, total flavonoid contents and free radical scavenging activity were detected in the studied extracts. Study by Delgado *et al.* (2009) showed that phenolic compounds are able to protect human cell against oxidative DNA damage and hence possess great anti-carcinogenic capabilities.

Sauryya *et al.* (2014) observed improved antioxidant activities and total phenolic content of extracts of A. viridis subjected to thermal processing and varied pH. This implies that the consumption of leaves of A. viridis will provide adequate antioxidants capable of preventing diseases which might arise from oxidative stress. Furthermore, the leaf and seed extracts of A. viridis have been reported to pose significant amount of total phenolic contents, flavonoid contents and radical scavenging ability. Besides, the extracts were also observed to show considerable antimicrobial activity. In conclusion, A. viridis leaf and seed can be explored as potential source for the isolation of antioxidants and antimicrobial agents for use in functional food formulation and pharmaceutical purposes (Ashok *et al.*, 2011; 2012).

### 3.4 *Crassocephalum crepidioides*

*Crassocephalum crepidioides* is a leafy vegetable that belong to the family Asteraceae and commonly called fireweed in English and "Ebolo" in the south western part of Nigeria. It is widespread in many tropical regions, subtropical regions and prominently in tropical Africa. Its fleshy, mucilaginous leaves and stems are eaten as a vegetable in some part of Africa while some parts of the plant have been employed for medical purposes in some other countries. C. crepidioides are good source of

protein, though low in some essential amino acid (Dairo and Adanlawo, 2007). It was suggested that supplementation with other rich sources of essential amino acids will make it nutritious for use as animal or human diets (Dairo and Adanlawo, 2007). In recent times, studies have demonstrated the antioxidant activity of *Crassocephalum crepidioides.* Odukoya *et al.* (2007) studies on the leaf extracts revealed remarkable antioxidant activity in linoleic acid model systems. Free radical scavenging and hepatoprotective actions of the plant had also been demonstrated in Japan where the plant grows wildly in the Okinawa Islands (Yoko Aniya *et al.,* 2005). It also well-known among folks as remedy for acute hepatitis and fever (Yoko Aniya *et al.,* 2005). Also, phytochemical screening of C. crepidioides revealed the presence of pharmacologically important substances such as tannins, coumarins, combined anthracene derivatives C-heterosides, flavonoids, mucilage, reducing compounds and steroids (Dansi *et al.,* 2013). One of the screened phytochemical Flavonoid' is a known and well researched antioxidant compound. In a study carried out by Ng *et al.* (2012), C. crepidioides methanolic extract showed higher antioxidant activity (90.04%) followed by *Etlingera elotoir* (89.23%), *Monochoria vaginalis (88.85%) and Limnophila aromaticoides* (76.91%) respectively and was comparably higher than the antioxidant activity of four Amaranths species reported by Amin *et al.* (2006). Water extracts of C. crepidioide was observed to strongly scavenged superoxide anion, hydroxyl radicals and stable radical of 1, 1-diphenyl-2-picrylhydrazyl. Iso chlorogenic acids, quercetin and kaempferol glycoside were identified as active components with strong free radical scavenging action (Tomoyuki *et al.,* 2005). Their results reaffirm the antioxidant potential of C. crepidioides and protective effects against Galactosamine, lipopolysaccharide or carbon tetrachloride (CCl 4) induced hepatotoxity.

### 3.5 *Solanum macrocarpon*

*Solanum macrocarpon* belongs to the Solanaceae family. The plant common name is Garden egg but referred to as *Igbagba* by the south western natives of Nigeria and *Gboma* by the Ghanaians. S. macrocarpon is believed to originate from West Africa but is now widely distributed in other of the continent such as the Central and East Africa. It is a tropical perennial plant that is closely related to the *Solanum melongena* otherwise called 'eggplant. The fruit and leaves of S. macrocarpon are consumed in the various regions where it is cultivated. Though the fruit and leaves are bitter and not too pleasant to taste, they have been reported to be highly nutritious. The leaves are rich in protein, crude fibre, fat, calcium and zinc (Oboh *et al.,* 2005) and are found to contain appreciable amounts of amino acid, methionine (Messiaen, 1999). The leaves have a variety of medicinal uses (Komalaga *et al.,* 2014). For example, in Sierra Leone boiled leaves are chewed to treat throat problems (Komalaga *et al.,* 2014); in Kenya the crushed leaves are taken to treat stomach problems (Bukenya and Bonsu, 2004). Asiedu *et al.* (2012) studies on S. macrocarpon revealed the leaves to be good source of antioxidants and they suggested modification in the storage and cooking practices of the leaves to ensured retention of the antioxidant contents for the best nutritional value and health benefit. The antigen, antioxidant and haematological parameters in prostatic rats fed with S. macrocarpon leaves were reported. Antioxidants markers such as Superoxide Dismutase, Glutathione-S-Transferase and glutathione levels increased significantly in prostrate rats fed with *S. macrocarpon*-supplemented diets (Emeka and Joyce, 2015). Also, the histological studies of animals fed *S. macrocarpon*- supplemented diets showed a considerable improvement in the prostatic histo-architecture. Emeka and Joyce (2015) in their study concluded that *Solanum* macrocarpon- supplemented diets may prevent or suppress the development of BPH and be useful in its treatment and management though further studies was suggested to confirm the effect of the plant on Benign prostrate

hyperplasia. It is an established fact that the consumption of foods rich in antioxidant can help prevent oxidative damage to cell. In addition to the chemical and properties discussed previously, the *in vitro* antioxidant effect of aqueous extract of *Solanum macrocarpon* leaves in rat liver and brain was investigated by Olusola *et al.,* 2014. The objective of the study was to investigate the ability of S. macrocarpon leaves to protect tissues against iron ($Fe^{2+}$)-induced lipid peroxidation in rat's liver and brain. *Solanum macrocarpon* leaves were observed to have high phenolic and flavonoid content. The leaves extract showed high percentage inhibition of lipid peroxidation induced by iron (II) sulphate and radical scavenging abilities. This study concluded by stating that the aqueous extract of *Solanum macrocarpon* leaves possess a powerful antioxidant activity and can offer good protection against oxidative damage to body cells, especially liver and brain. Extracts of *Solanum macrocarpon* have been shown to possess antioxidant properties and inhibitory effect on starch hydrolysing enzymes. Nwanna *et al.* (2013) showed the antioxidant properties of the methanolic extracts of Solanum *macrocarpon* fruit using the DPPH scavenging test. It was also found to have phenolic and total flavonoid content which was found to be significantly higher than *Solanum melogena.* The ferric reducing antioxidant capacity (FRAP) of the extracts reported as ascorbic acid equivalent which is the ability of the phenolic extracts to reduce Fe (III) to Fe (II); a measure of their antioxidant properties was found to have higher ($P < 0.05$) reducing power (56.67 mg/100 g) than S. melongena (48.78 mg/100 g). Their inhibitory effect and antioxidant properties suggested the potential use of the plant in the dietary management or control of postprandial hyperglycemia associated with type-2 diabetes. Komlaga *et al.* (2014) evaluated the leaves of S. macrocarpon for its pharmacognostic characteristics and antioxidant properties. Basic phytochemical screening revealed the presence of tannins, flavonoids and alkaloids. The alcoholic extract showed radical scavenging activity with $IC_{50}$ of 2.42mg/ml. The pharmacognostic standards and antioxidant activity of the leaves was established and were said to be essential pharmacognostic standards for the identification of the plant.

## 4. CONCLUSIONS

This study has reviewed only few vegetables with chemo-preventive, pharmacological and antioxidant properties grown in Nigeria which affirms some of their use, both for their nutritional and medical purposes. Consumption of UIV might be beneficial health wise given that some of these vegetables are functional foods with medicinal, antioxidants and pharmacological properties. Identifying UIV of good antioxidant content could be major step in the sourcing of natural antioxidants in food system and reduction of the role of artificial antioxidants which had been implicated as a promoter of a number of illnesses such as carcinogenesis. There is a need to create awareness for UIV cultivation and consumption considering that they are nutritious, health promoting, easy to cultivate and produce stable yields even under difficult climatic and edaphic conditions. The consumption of these vegetables is capable of preventing and protecting against some of the diseases arising from the effect of oxidative damages cause by free radicals and ROS in both humans and livestock.

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